

2004

ENERGY REGULATORS REGIONAL ASSOCIATION



# ISSUE PAPERS

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# Table of Contents

<b>INTRODUCTION.....</b>	<b>4</b>
<b>ERRA LICENSING/COMPETITION COMMITTEE:.....</b>	<b>6</b>
<b>EVALUATION OF THE STATUS OF SECURITY OF SUPPLY IN ERRA COUNTRIES.....</b>	<b>6</b>
BACKGROUND .....	6
DEFINITIONS .....	7
THE ANALYSIS .....	7
<i>The aim</i> .....	7
<i>Characteristics of the sample to be analysed</i> .....	8
RESULTS .....	8
1. <i>Some elements of regulatory risk</i> .....	8
2. <i>Responsibilities</i> .....	9
3. <i>Potential regulatory intervention</i> .....	10
II. GENERATION.....	12
1. <i>Resource adequacy</i> .....	12
2. <i>Import dependency in 2002</i> .....	17
3. <i>Market concentration</i> .....	19
4. <i>Generating capacity mix</i> .....	20
5. <i>Age of generators</i> .....	22
6. <i>Adequate structure of reserve capacity</i> .....	24
7. <i>Entry barrier – electricity production prices</i> .....	25
8. <i>Depreciation, Maintenance, Investments</i> .....	27
8. <i>Demand side solutions</i> .....	28
III. NETWORKS.....	30
1. <i>Unbundling of TSO/ISO</i> .....	31
2. <i>Cost shares of electricity supply</i> .....	31
3. <i>Interconnectors</i> .....	32
4. <i>Features of network</i> .....	33
5. <i>Quality of supply – congestions, breakdowns</i> .....	34
IV. FINANCIAL INDICATORS .....	35
<b>ERRA TARIFF/PRICING COMMITTEE: .....</b>	<b>38</b>
<b>PERFORMANCE EVALUATION FOR POWER DISTRIBUTION COMPANIES .....</b>	<b>38</b>
I. INTRODUCTION .....	39
II. PERFORMANCE EVALUATION FOR POWER DISTRIBUTION COMPANIES .....	39
A. <i>Partial (one-dimensional) measures of performance</i> .....	39
B. <i>General (overall) measures of performance</i> .....	42
i) <i>Parametric methods of performance evaluation</i> .....	43
ii) <i>Non-parametric methods of performance evaluation</i> .....	45
C. <i>Use of efficiency analysis methods in regulating natural monopolies</i> .....	47
D. <i>Performance evaluation of Ukrainian power distribution companies (Oblenergo)</i> .....	49
E. <i>International benchmarking of power distribution companies</i> .....	57
III. QUALITY ASSESSMENT OF CONSUMER SERVICES .....	58
A. <i>The need to regulate service quality</i> .....	58
B. <i>Main areas of service quality regulation</i> .....	58
i) <i>Network safety and reliability</i> .....	59
ii) <i>Continuity of services (reliability of supply)</i> .....	61
iii) <i>Power Quality</i> .....	62
iv) <i>Commercial quality</i> .....	63

<i>C. Service quality regulation principles</i> .....	64
<i>D. Service quality regulation mechanisms</i> .....	65
<i>E. System of service quality regulation in the Hungarian power sector</i> .....	65
i) Reporting of license holders on service quality issues .....	66
ii) Evaluation of the opinion of consumers on the quality of provided services.....	67
iii) Guaranteed and general service quality standards .....	68
IV. QUESTIONNAIRE AND IT'S RESULTS .....	69
V. References .....	73
<b>ERRA LEGAL REGULATION WORKING GROUP: .....</b>	<b>76</b>
<b>GLOSSARY OF LEGAL TERMS .....</b>	<b>76</b>
A .....	77
B .....	78
C .....	78
D .....	80
E .....	82
F .....	84
G .....	84
H .....	85
I .....	85
J .....	86
L .....	86
M .....	87
N .....	87
O .....	88
P .....	88
R .....	89
S .....	90
T .....	91
U .....	92
V .....	93
W .....	93

# Introduction

*Dear Colleagues:*

I am delighted to welcome you to the 5th Annual Conference of the Energy Regulators Regional Association and present you the collection of issue papers prepared by the ERRA Tariff/Pricing and Licensing/Competition Committees and by the newly established Legal Regulation Working Group!

ERRA has grown remarkably in the past years, we have grown both in terms of international recognition and respect in the ERRA region. The ERRA Conferences and publications are acquiring increased interest and are very popular.

In this publication you will find the following documents: (1) Evaluation of the Status of Security of Supply in ERRA Member Countries – prepared by members of the Licensing/Competition Committee. The paper first looks at the institutional and legal framework of ERRA countries in order to assess potential regulatory risks. Then gives an analysis of volume and changes of installed and available capacity, changes of annual peak demand, ratio of reserve margins, networks and financial indicators. (2) Performance Evaluation for Power Distribution Companies – prepared by members of the Tariff/Pricing Committee. The paper deals with assessment of supply quality and gives the result of the ERRA Questionnaire on this topic. (3) Legal Glossary of legal terms for better common understanding among the ERRA region. The Glossary was prepared by members of the newly formed ERRA Legal Regulation Working Group. I hope that ERRA members will benefit professionally from this set of papers and that it will prove to be informative and instructive.

I would like to express my sincere appreciation to all ERRA members for making these valuable papers available to other members of our Association and to the public. At the same time, I would like to thank the continuous technical support received from the National Association of Regulatory Utility Commissioners (NARUC) and the U.S. Agency for International Development (USAID). I look forward to ERRA's continuous future growth.

Sincerely,



*Dr. Vidmantas Jankauskas*

Chairman, ERRA

Chairman, National Control Commission for Prices and Energy, Lithuania

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This publication was made possible through support provided by the Energy and Infrastructure Division of the Bureau of Europe and Eurasia under the terms of its Cooperative Agreement with the National Association of Regulatory Utility Commissioners, No. EE-N-00-99-00001-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development or National Association of Regulatory Utility Commissioners.

# ERRA Licensing/Competition Committee:

## Evaluation of the Status of Security of Supply in ERRA Countries

### ISSUE PAPER

*Prepared by Ms Zsuzsanna Tassy, Mr Attila Bakonyi and Dr. Gabor Szorenyi,  
Hungarian Energy Office*

- 2004 -

### **BACKGROUND**

The issue of security of supply (SoS) has become of utmost interest due to the increasing demand, investments slowing down in the changing regulatory environment (liberalisation) and the big blackouts at first in California, then in Italy and several near-blackout situations occurred last year throughout the world drew the attention to this issue.

In addition to several literatures and studies quoted in this report also the Directorate-General for Transport and Energy of the European Commission (DG TREN) had a bulky study on this subject prepared, which was issued in January 2004<sup>1</sup>. This study assumes that “the dependency on imported energies will increase substantially in the coming decades and that the uninterrupted flow of energy will depend on the political and economic stability of the producer regions”<sup>2</sup>. That is why it recommends to include energy issues more prominently in external trade and foreign and security policy-making.

It also highlights the importance of this issue that the EC DG TREN issued a proposal for a directive on supply security in addition to the new Directives, which also places the issue of SoS into the spotlight.

In the framework of the work of the Council of European Energy Regulators (CEER) a separate Task Force (TF) of the Single Market Working Group is dealing with SoS. The TF

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<sup>1</sup> Study on Energy Supply Security and Geopolitics, January 2004

<sup>2</sup> Study on Energy Supply Security and Geopolitics, January 2004 (p. 15)

focuses on the following aspects of SoS among others: emergency regulation, power system security criteria (n-1 principle), and methodology for validation of non-delivered energy.

Apparently, EU focuses mainly on short-term approaches, which must be triggered by the actual problems of the last years.

The frame and structure of this analysis however is mainly based on the IEA study on Security of Supply in Electricity Markets published in 2002. This study – compared with current EU approaches – construes SoS in a broader scope. It has three aspects: enough generating capacity to meet demand; adequate portfolio of technologies to deal with variations in the availability of input fuels; adequate transmission and distribution networks to transport electricity.

We think that this type of approach (emphasising long-term and investment approaches) fits better to ERRA relations, since ERRA member states do not have as interdependent relations as EU member states have, and ERRA cannot aim to create common rules binding for its member states. Therefore the objective of this analysis had to be restricted to assess the situation of SoS in ERRA states, highlighting long-term SoS issues.

## **DEFINITIONS**

The three elements of the definition of SoS, which is widely used by other literatures and this analysis was prepared also based on this definition.

Reliability: the capability of the electricity system to deliver to customers the desired amount of energy, of a defined quality (Nordel)

Security: readiness of the installed available capacity

Adequacy: the ability of the electricity system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into consideration scheduled and reasonably expected unscheduled and outages of system elements (NERC)

## **THE ANALYSIS**

### **The aim**

In the first phase the aim of this analysis is to outline what are the best methods to assess SoS, to specify the appropriate indicators and evaluate the information received.

In the next phase of this work the fine-tuning of this analysis will go on (completion of analysis with the answers received after deadline and with other comments) We also plan to have a deeper insight in the up-to-date work and findings of the EU and the U.S. with regard to SoS.

## **Characteristics of the sample to be analysed**

Questionnaires were sent to 20 countries in the middle of December 2003. Answers were collected, analysed and presented in the form of an interim or preliminary report on the findings of the analysis in the Licensing/Competition Committee Meeting in Bucharest in February 2004.

Taking into account the comments and remarks of the presentation, which were very useful and for which we thank all the contributors, tables were compiled based on the questions and answers, sometimes with clarification or modification of the questions. These tables were sent again to the member states for further checking and clarification. Finally 16 of the 20 countries responded to the questionnaire. 13 respondents answered more than 70% of the questions (Albania, Armenia, Bulgaria, Croatia, Estonia, Latvia, Lithuania, Moldova, Mongolia, Slovakia, Romania, Turkey and Hungary). Ukraine and Russia filled in less than 50% of the questionnaire, and no answers were received from Poland, Czech Republic, Kazakhstan and Kyrgyz Republic. Data were gained from sources other than the answers, namely from ERRA database (prices), the cited IEA study on SoS (installed capacity), DG TREN study on Energy Supply Security and Geopolitics (market share) and the 3<sup>rd</sup> Benchmarking Report of the European Commission (interconnection). If not indicated else, sources of tables and figures are the answers given to the questionnaire. Although the analysis is not complete, there were sufficient data available to analyse and draw some conclusions.

## **RESULTS**

### **I. Organisation and institutional framework**

In the first part we are going to analyse the organisational, institutional and legal framework, which aimed to assess some elements of regulatory risk and to map responsibilities with regard to SoS, since this influences the investors' trust, willingness and costs of credits /capital/ and through this, the costs of investments and energy supply.

### **1. Some elements of regulatory risk**

In most of the responding countries the regulator issues licenses, except Lithuania and Russia, where ministry issues those. It is also the regulator, who is the price authority in most of the responding states, however, in Croatia, Hungary and Moldova the minister is responsible for price setting. The picture is uniform with regard to the fact that the decisions of regulators can be challenged exclusively on Court. States seem to provide appropriate authorisation procedures, since the average duration of the authorisation procedure is 1-3 months. Turkey allows more time for the administrative procedure of authorisation: 4.5 months. See Table 1.

Secure legal framework including stabile laws and independent regulators is a condition for attracting investors. The quality of administrative procedures does not have crucial and direct influence on the investing will, however it may cause inconveniences and retard the process of investment.

Table 1 – Procedure of authorisation

	Average wait (month) between applying for and obtaining generation plant authorisation	Number of generation plant applications			
		Received per year		Granted per year	
		2001	2002	2001	2002
<b>Albania</b>	3	1	2	1	2
<b>Armenia</b>	60 days	4	5	4	5
<b>Bulgaria</b>	3	5	4	5	4
<b>Croatia</b>	no such procedure	0	0	0	0
<b>Estonia</b>	2	Until July 2003 no separate license was needed for generation			
<b>Georgia</b>	1	0	0	0	0
<b>Hungary</b>	3	2	3	2	3
<b>Latvia</b>	1	2	3	2	3
<b>Lithuania</b>	30 days	39	21	39	21
<b>Moldova</b>	2	0	0	0	0
<b>Mongolia</b>	2	0	0	2	3
<b>Romania</b>	1-2	3	1	3	1
<b>Russia</b>	n.a.	n.a.	n.a.	n.a.	n.a.
<b>Slovakia</b>	3	2	3	2	3
<b>Turkey</b>	4,5	0	316	0	0
<b>Ukraine</b>	n.a.	n.a.	n.a.	n.a.	n.a.

Source: questionnaire

Regulators may facilitate investment willingness by establishing transparent and well-declared licensing conditions and procedures.

## 2. Responsibilities

The process for determining the volume of investment (capacity of new generation) needed for ensuring long-term SoS differs from country to country. In liberalised markets it should be the TSO who is involved in this process as the one possessing all the necessary technical information. There are different scenarios, how decisions on investment are made based on the information of TSO, and which stakeholders are included in the decision-making. The most liberal solution is when decisions on investments are left totally to the market. Turkey and Hungary are the closest to apply this approach. In Turkey and in Hungary it is the TSO that prepares a demand/capacity forecast, which is the base for private investors or the incumbent generator to make their decision on investment. In most ERRA countries investments are not left fully to the market. According to this survey in Lithuania the regulator makes the decision upon the proposal of the TSO. In Romania the decision is

made by the ministry and approved by the governments in the framework of their National Energy Strategy. In Estonia the Energy Company, in Albania the vertically integrated monopoly makes the decisions.

On an effective competitive market, market players take the risk based on the reliable and independent estimation of demand and existing sources to build power plants at the time, place, speed and size they wish. It is also their risk to choose site and fuel. If the state interferes (apart from the general, pre-established energy-political aspects accessible for everyone), it takes over the risks, and makes its own tax-payers, i.e. customers pay for the costs.

Another situation occurs when supply problems may be expected in the short and middle run, and the state is forced to interfere – in the lack of the automatic adjustment of the market. Regulatory tools applicable in these cases will be discussed in the next chapter.

The regulator may encourage investors' decision by facilitating access to the reliable information necessary for the decision at the TSO, and by checking, commenting and completing those.

### **3. Potential regulatory intervention<sup>3</sup>**

There are some ERRA countries where the regulator does not have any statutory power to intervene in ensuring SoS in case the market does not work properly to ensure new capacity construction. These are for example Slovakia, Russia, Albania, Croatia and Armenia. In countries where the regulator has right and obligation to intervene, several forms of intervention exist. There are several regulatory approaches and means applied or proposed to deal with the issue of SoS.

#### **Capacity payments**

Generators get administratively determined payment in proportion of its estimated contribution to the reliability of the system. In the first step the global amount of capacity payments has to be determined based on the target adequacy level and the prescribed price cap, then this amount has to be allocated to generators.

Problems of this system are: (i) complexity; (ii) endless disputes between generators and regulator (iii) no commitment from generators – no guaranteed level of adequacy.

This tool is implemented in Chile, Argentina, Columbia, Peru, Brazil, Spain; regarding ERRA countries: in Lithuania and in Georgia.

#### **Strategic capacity reserves (peaking units)**

System operator – following the instructions of the regulator – purchases some or all capacities of peaking units. The incurred costs are charged to customers. The resulting

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<sup>3</sup> The following papers were used for this chapter: Carlos Vázquez; Michel Rivier; Ignacio J. Perez-Arriaga (2002): A market approach to long-term security of supply; Ignacio J. Perez-Arriaga (2001): Long-term reliability of generation in competitive wholesale markets. A critical review of issues and alternative options; Summary made by the Department for Economic Research and Environmental Protection of the HEO on the basis of the aforementioned studies; a study of Charles Zimmermann

capacity payments are allocated to the selected generators. Strategic capacity reserves are under full operational control of the system operator.

Problems of this system are: (i) breakdown of the market into two different part (ii) increasing possibility of artificial scarcity and high prices

This mean is implemented in Sweden, Finland, Italy, England & Wales; regarding ERRA: in Lithuania and Hungary

### **Tendering**

The regulator or other authority supervises the generation adequacy according to some pre-established criteria. In case the authority considers that there is a threat of insufficient generation capacity and a lack of entry of new generation at the same time, it may start a tendering procedure for the addition of the required extra capacity.

Problems of this solution are: (i) tendering is forbidden by the new EU directive except when used as exceptional measure for reasons of security of supply (ii) requires double surveillance of generation capacity

This tool is implemented in France, Portugal; regarding ERRA: in Hungary

### **Capacity market**

“Purchasing entities” (e.g. large customers, suppliers, traders etc.) are required to purchase firm generation capacity to cover their expected annual peak load plus a regulated margin (mandatory contract coverage). The regulator determines the amount of firm capacity that each generation unit can provide. The generators must have the committed firm capacity available whenever they are required to produce, since committed but unavailable capacities are subject to heavy fine.

Problems of this approach are: (i) determining the amount of firm capacity (ii) consumers remain fully exposed to high prices (iii) price of capacity may be very volatile (depending on the tightness of the margins of installed capacity) – uncertainty in the remuneration of generators (iv) no guarantee for security of supply (eg. electricity export by available generator)

modification: freely chosen reliability levels (customers are not required to contract firm capacity); problems are (i) free riding (ii) limited possibility to selectively disconnect customers

This solution is implemented in USA (PJM, NYPP); regarding ERRA: in the future Romania

### **Reliability contracts**

The system of reliability contracts has been elaborated by the team of I. J. Perez-Arriaga, thus it is in an experimental phase, and we do not know about its implementation<sup>4</sup> The substance of this system is an organized market, where the regulator requires the system operator to buy a prescribed volume of reliability contracts from generators. “This volume must be such that a satisfactory level of generation adequacy is obtained (...). Reliability contracts allow customers to obtain a price cap on the market price in exchange for a fixed remuneration for the generators. Additionally, customers obtain a satisfactory guarantee that there will be enough available generation capacity whenever it is needed. Otherwise

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<sup>4</sup> Ignacio J. Perez-Arriaga: Long-term reliability of generation in competitive wholesale markets (IIT Internal report, June 2001)

generators will be penalised. Generators are also compensated economically for this service: the higher the contribution to the reliability of the system, the higher the compensation will be (this is automatically built-in in the procedure, not and administrative decision).” Reliability contracts consist of the combination of a financial call option with high strike prices and an explicit penalty for non-delivery.

The most liberal approach is the leave-it-to-the-market principle. Without any special measures and inventions customers would be willing to pay more for protecting themselves against blackouts and high prices in the time period, when there are less available capacity than demand. However, this principle seems to be dangerous, as it has been proved by the California and Midwest USA example. In addition to the mentioned states of the US, Australia and the Nordic countries implement this approach<sup>5</sup>. Since none of the ERRA countries have well-functioning markets, this is not typical for them. Therefore until the effective market is established or in the case of predictable capacity insufficiencies it is appropriate to empower regulators by law to be able to introduce any of the methods analysed above or other proper procedure.

The other extreme approach, which has been typical for vertically integrated utility is lacking for any regulatory intervention. In this case the issue of SoS is a part of the centralised utility planning. Examples can be found in several states of ERRA (e.g. Russia, Albania, Armenia etc.)

## **II. GENERATION**

### **1. Resource adequacy**

In this section we examined the volume and changes of installed and available capacity, the changes of annual peak demand, and the ration of reserve margin. In the first questionnaire we defined installed capacity as domestic generation capacity + import capacity, however, in the second round, when tables were sent back to the countries, we tried to approach the UCTE definition, therefore regulators were asked to recalculate the figures according to the following definition: installed capacity = domestic generation capacity including nuclear, conventional thermal power plants and renewables + industrial autoproduction. Similarly, the definition of available capacity was modified for the same purpose as follows: available capacity= installed capacity – outages. Only some of the figures were changed afterwards, therefore only trends and ratios can be examined.

When calculating the values of installed capacity, regulators were asked to take into account only the capacity of units already operating and planned to be in operation in 2007, in order to show the decrease of now existing capacities (rejection of spoilage, planned decommissioning)

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<sup>5</sup> Both Australia and Nordic states have well-functioning electricity market with liquid power exchange, which delivers indicative price signals to investors interested in generation.

Table 2 – Installed capacity (GW)

	2000	2001	2002		2007
<b>Albania</b>	1,6	1,6	1,6		1,6
<b>Armenia</b>	3,3	3,3	3,3		3,3
<b>Bulgaria</b>	10,1	10,1	10,1		9,0
<b>Croatia</b>	n.a.	n.a.	n.a.		n.a.
<b>Czech Republic*</b>		16,0	15,3		15,3
<b>Estonia</b>	3,2	3,2	3,0		2,6
<b>Georgia*</b>		4,5	4,5		4,5
<b>Hungary</b>	8,2	8,9	8,6		7,9
<b>Kazakhstan*</b>		17,3	17,2		17,2
<b>Kyrgyz Republic*</b>		3,8	3,6		3,6
<b>Latvia</b>	2,9	2,9	3,0		3,0
<b>Lithuania</b>	6,2	6,2	6,2		5,0
<b>Moldova</b>	0,4	0,4	0,4		0,4
<b>Mongolia</b>	0,8	0,8	0,8		0,8
<b>Poland*</b>		35,0	34,6		34,6
<b>Romania</b>	16,3	18,8	18,9		16,8
<b>Russia</b>	216,6	207,8	206,2		191,2
<b>Slovakia</b>	8,3	8,3	8,3		7,9
<b>Turkey</b>	27,3	28,0	31,8		28,0
<b>Ukraine*</b>		53,7	51,0		51,0
<b>Total</b>		430580	428430		404000

Source: questionnaire

\* Third benchmarking report of DG TREN on the implementation of the internal electricity and gas market and 2<sup>nd</sup> ERRA regulation and Investment Conference, US DOE

Figure 1 – Existing installed capacity – Total

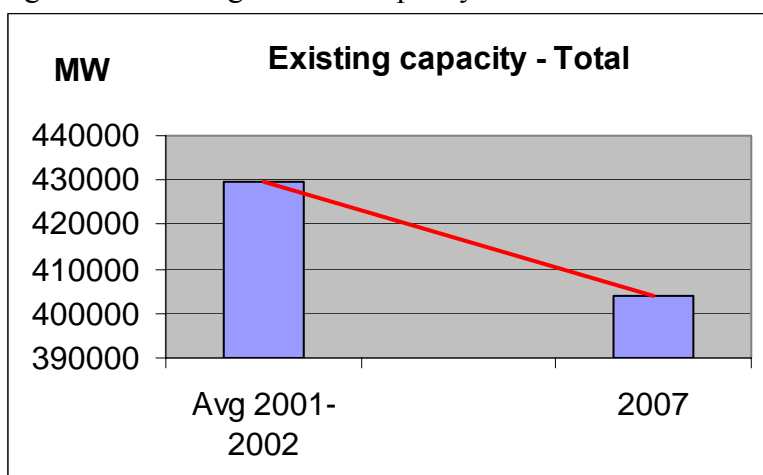


Table 3 - Annual peak demand (GW)

	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>...</b>	<b>2007</b>
<b>Albania</b>	4,0	4,1	4,7		6,0
<b>Armenia</b>	1,0	1,1	1,1		1,1
<b>Bulgaria</b>	7,6	6,9	6,8		7,9
<b>Croatia</b>	2,7	2,8	2,7		3,2
<b>Czech Republic</b>					
<b>Estonia</b>	1,3	1,3	1,3		1,5
<b>Georgia</b>					
<b>Hungary</b>	5,7	6,0	6,0		6,5
<b>Kazakhstan</b>					
<b>Kyrgyz Republic</b>					
<b>Latvia</b>	2,0	2,0	2,0		2,3
<b>Lithuania</b>	1,8	1,9	2,0		2,2
<b>Moldova</b>	0,5	0,5	0,6		0,8
<b>Mongolia</b>	0,5	0,5	0,5		0,5
<b>Poland</b>					
<b>Romania</b>	8,2	8,6	8,4		9,8
<b>Russia</b>	136,8	138,7	141,6		149,4
<b>Slovakia</b>	4,3	4,4	4,4		4,8
<b>Turkey</b>	19,4	19,6	21,0		32,7
<b>Ukraine</b>					
	<b>2000</b>	<b>2001</b>	<b>2002</b>		<b>2007</b>
<b>Total</b>	36,4	36,8	37,3		42,7

Source: questionnaire

The total figures of installed capacity and annual peak demand cannot be compared to each other as the total of annual peak demand reflects less countries than in the case of installed capacity, where the figures of all countries were available, only trends and ratios can be evaluated.

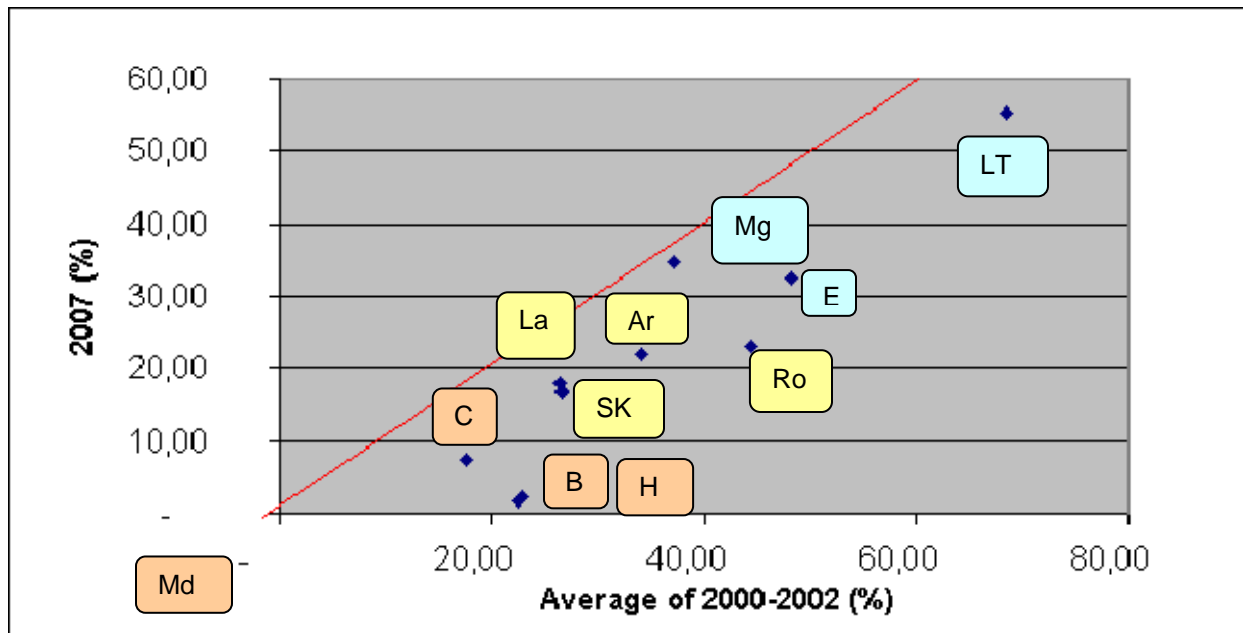
Installed capacities (without new investments) are forecasted to decrease by 6% from 2002 to 2007 in the ERRA region. However, the annual peak demand is expected to grow by 15.3% from 2002 to 2007 in average, but the variation is significant (min. 2.9% - Armenia, max. 63.3% - Turkey).

Table 4 – Reserve margin (calculated on available capacity) (%)

	2000	2001	2002		2007
Albania	14,96	14,93	14,93		24,55
Armenia	38,00	33,00	31,00		22,00
Bulgaria	17,50	24,70	26,30		2,20
Croatia	19,80	14,70	18,10		7,40
Czech Republic					
Estonia	53,50	46,00	45,00		39,10
Georgia					
Hungary	25,00	26,20	16,00		1,70
Kazakhstan					
Kyrgyz Republic					
Latvia	26,70	26,50	25,90		18,00
Lithuania	70,00	68,10	67,40		55,40
Moldova	- 17,20	- 15,60	- 21,10		- 20,00
Mongolia	38,05	37,10	36,10		34,70
Poland					
Romania	43,00	44,00	46,00		23,00
Russia					
Slovakia	22,30	25,50	32,00		16,70
Turkey	10,40	12,40	0,50		17,50
Ukraine					
Unweighted average	27,85	27,50	26,01		17,29

Source: questionnaire

Figure 2 – Reserve margin (available capacity)



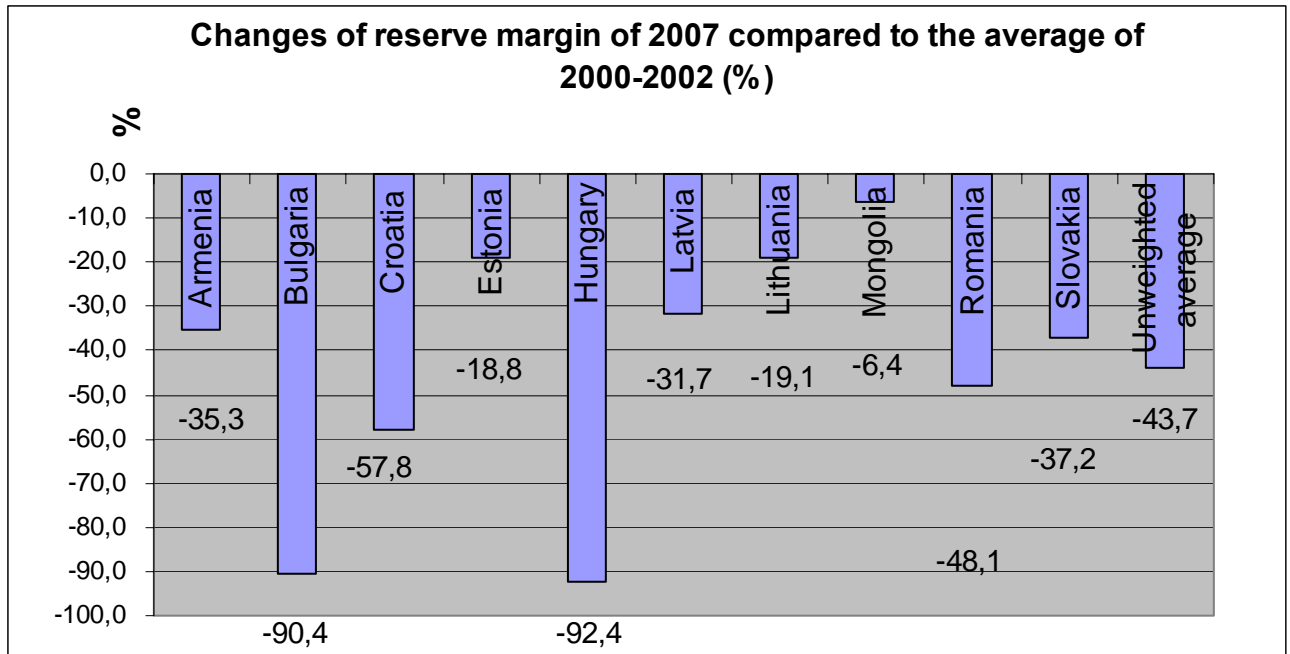
Despite the fact that regulators were asked to calculate forecasted reserve margins without new investment, some countries calculated this index including new investment, which you can read in Table 4, however those are not indicated in Figure 2. Axis X of figure 2 depicts the current reserve margin and projecting the mark of the country to axis y it shows the forecasted values of reserve margin.

The typical engineering targets for reserves are 18-25%.

Colours indicate reserve margin levels. Red coloured countries are under the typical engineering target, yellow coloured countries are around the target and blue coloured countries are above that as present and in 2007 without new investment in generation. Countries on the red line would be countries where reserve margin would remain unchanged from 2002 to 2007. Countries are situated below the line, which indicates the more and less significant reduction of reserve margins.

The magnitude of decrease is illustrated on Figure 3. Countries where new investments were included in calculation are missing from chart.

Figure 3



This clearly demonstrates the even regulators of ERRA countries should take definite steps to incentive new power plant capacities possibly with the above analysed market-conform tools.

## 2. Import dependency in 2002

High import dependency may encourage competition due to cheap import prices, however, in an extreme case, in the lack of domestic generation capacities import may be a monopoly that is able to push prices up. Political conflicts may jeopardise supply.

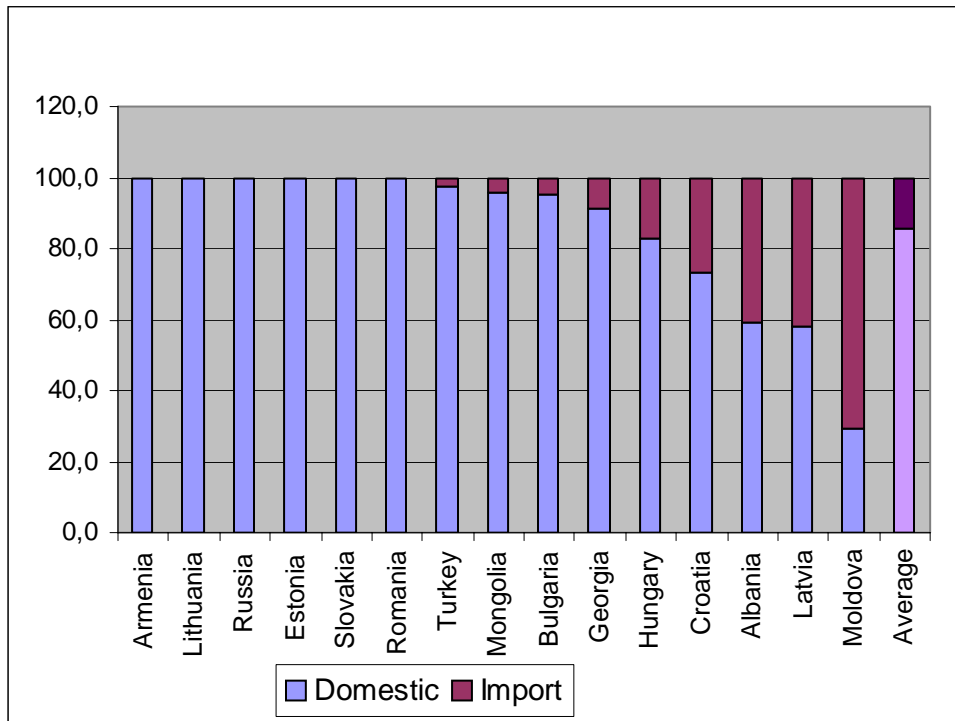
Table 5 – Import dependency

	Proportion of sources (%)	
	Domestic	Import
<b>Armenia</b>	100,0	0,0
<b>Lithuania</b>	100,0	0,0
<b>Russia</b>	100,0	0,0
<b>Estonia</b>	100,0	0,0
<b>Slovakia</b>	100,0	0,0
<b>Romania</b>	99,6	0,4
<b>Turkey</b>	97,2	2,8
<b>Mongolia</b>	95,6	4,1
<b>Bulgaria</b>	95,0	5,0
<b>Georgia</b>	91,0	9,0
<b>Hungary</b>	82,8	17,2
<b>Croatia</b>	73,3	26,7
<b>Albania</b>	59,0	41,0
<b>Latvia</b>	58,0	42,0
<b>Moldova</b>	29,1	70,9
<b>Average</b>	85,4	14,6

As Figure 4 shows, 8 of the 14 respondents are almost self-suppliers. The most dependent countries are Moldova, Latvia, Albania. Hungary and Croatia are around the unweighted average of the responding countries.

It would be interesting to examine further to what extent countries use import for capacity supplement and for pure commerce (purchased at competitive price).

Figure 4 – Import dependency



In countries where the share of import is significant, regulators must particularly take care of the introduction of transparent cross-border capacity allocation methods.

### 3. Market concentration

Theoretically, oligopolistic market structure favours investments, while monopolistic market structure may make it hard to conduct private business for new entrants other than the vertically integrated, generally state-owned company.

Countries of the region can be divided into countries of oligopolistic market structure, which is associated with more or less opened up markets and ones of monopolistic structure as it is shown by the table below.

Table 6

	Share in total capacity			Share in total generation		
	Market share of the largest generator (%)	Market share of the 3 largest generator (%)	Number of generators with market share of 5% or above	Market share of the largest generator (%)	Market share of the 3 largest generator (%)	Number of generators with market share of 5% or above
Albania	100	100	1	100	100	1
Armenia	33,7	67,4	5	23,4	35,2	4
Bulgaria	29,6	47,4	5	53	79,3	5
Croatia	100	100	1	100	100	1
Czech Republic	66*	76*	1*			
Estonia	90*	96*	2*			
Georgia	41	62	6	45	72	6
Hungary	28,1	63,8	5	41,4	69,8	6
Kazakhstan						
Kyrgyz Republic						
Latvia	41	75	5	37	81	5
Lithuania	41,7	76,8	4	79,9	90,2	2
Moldova	55,3	75,2	3	75,5	89,6	3
Mongolia	69,5	92,6	3	66,7	92,2	3
Poland	14*	35*	8*			
Romania	30	48	6	25	56	7
Russia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	82,8	97,6	1	85	89,8	1
Turkey	52,3	66,9	2	37,2	58,8	2
Ukraine						

\* Source: Third benchmarking report of DG TREN on the implementation of the internal electricity and gas market

Countries where a few generators have dominant role, should face the problem, that they must ensure resources for new generation investments by themselves or elaborate a special guarantee-system to incentive private investments. In countries with oligopolistic market more simple incentive systems are expected to be sufficient.

#### 4. Generating capacity mix

In the former COMECON<sup>6</sup> countries, because of the intimate relations with the former Soviet Union, Eastern-European countries received ample oil at low prices from the Soviet Union, while coal production in Hungary, Poland and Czech Republic was also important. Based on the findings of this questionnaire and referring to the DG TREN report on SoS<sup>7</sup>, we can state that the coal continues to play an important role in those countries' primary energy mix (65% -Poland, 49%- Czech Republic, 41% - Bulgaria and Hungary). The existing gas infrastructure in the majority of the accession countries firmly links to the Russian source. Russia provides between 74 and 100% of all gas imports of these countries. That is the reason why the provision of the latest Proposal for a European Parliament and Council Directive concerning the security of natural gas supply, which would require the accession countries to hold emergency stocks of gas, would have double-edged effect. On one hand it would contribute to EU security of supply, however on the

<sup>6</sup> Council for Mutual Assistance: organisation that was set up in 1956 for the coordination of economic policy between the communist states of the Eastern bloc.

<sup>7</sup> Study on Energy Supply Security and Geopolitics- Final report, Jan 2004 (CIEP)

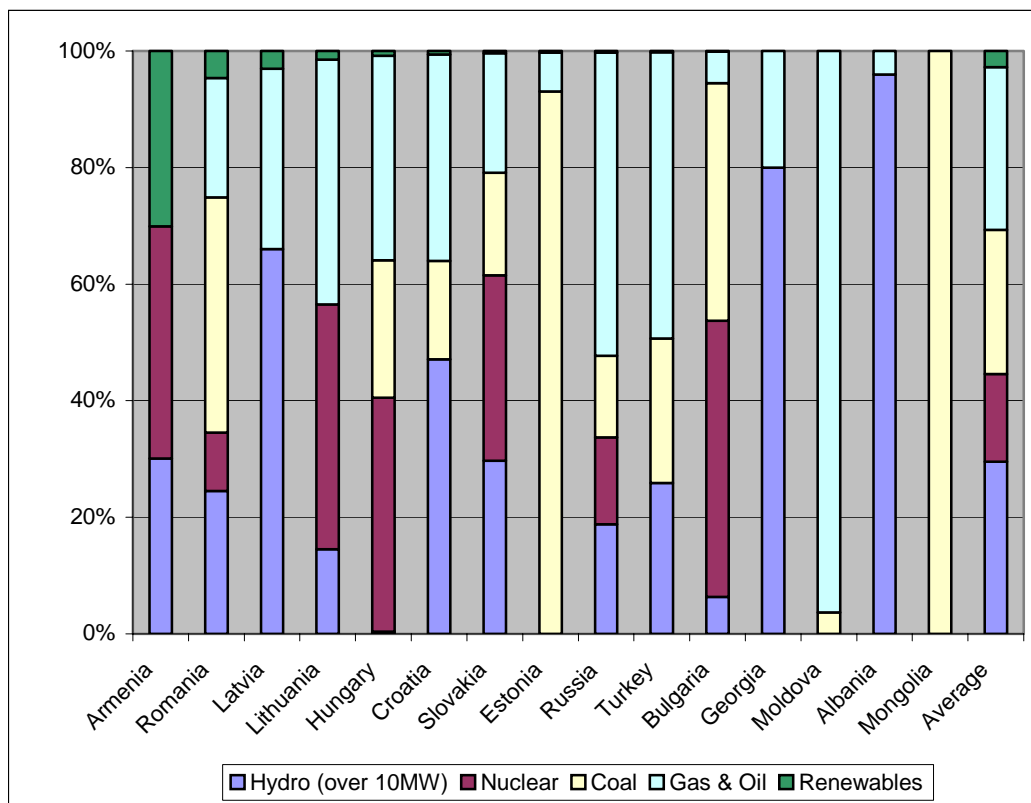
other hand it would be against the obligation of diversification of natural gas sources, because these countries strongly depend on the single, Russian supplier. Countries like Poland and the Baltic countries intend to diversify their gas imports and turned also toward Danish and Norwegian sources.

Another finding of this question is the generally low proportion of renewable in fuel mix (apart from hydro generation). It may reflect that on one hand the motivation to apply renewables is far smaller in ERRA countries than eg. in the “old” European Union countries, and on the other hand also the environmental consciousness of these countries is lower than it should be.

Table 7

	<b>Distribution of fuel sources (%)</b>				
	<b>Hydro (over 10MW)</b>	<b>Nuclear</b>	<b>Coal</b>	<b>Gas &amp; Oil</b>	<b>Renewables</b>
<b>Armenia</b>	29,28	38,87			29,27
<b>Romania</b>	24,5	10	40,4	20,5	4,6
<b>Latvia</b>	66	0	0	31	3
<b>Lithuania</b>	14,5	42	0	42	1,5
<b>Hungary</b>	0,4	40,1	23,6	35,1	0,8
<b>Croatia</b>	47,1		16,9	35,4	0,6
<b>Slovakia</b>	29,7	31,8	17,6	20,5	0,4
<b>Estonia</b>	0	0	93,1	6,6	0,3
<b>Russia</b>	18,8	14,9	14	52	0,3
<b>Turkey</b>	25,9	0	24,8	49,1	0,2
<b>Bulgaria</b>	6,3	47,4	40,8	5,4	0,1
<b>Georgia</b>	80	0	0	20	0
<b>Moldova</b>	3,7	0	0	96,3	0
<b>Albania</b>	96	0	0	4	0
<b>Mongolia</b>	0	0	100	0	0
<b>Average</b>	29,48	15,00	24,75	27,86	2,74

Figure 5 Generation: fuel mix



Governments and regulators of countries, where the distribution of the basic energy carriers is one-sided, should make analyses assessing the size of supply risk and price risk. In case risk analyses indicate potential danger, appropriate incentive system will be necessary in order to balance out generation mix. However, these incentives should be avoided to be discriminative, and based on state intervention of concrete projects.

## 5. Age of generators

In general, we can state that the power plants are old in the ERRA countries. 60% of the power plants according to the installed capacity of them are older than 20 years, 22% of them are between 10 and 20 years, and only the remaining 18% are younger than 10 years. This probably means that in the following couple of years many power plants will finish the electricity production and will be decommissioned, rehabilitated, life-extended or upgraded, and/or there will be an increasing need to build new power plants, which means that regulators should create a sound and comfortable regime for new investments (especially when the government is not interested in generation investments).

If we compare a hydro power plant and a conventional one, the age has a different meaning because of the different lifetime and operation, that is why we do not examine the hydro power plants in this study.

Figure 6 – Age of generators excluding hydro power plants

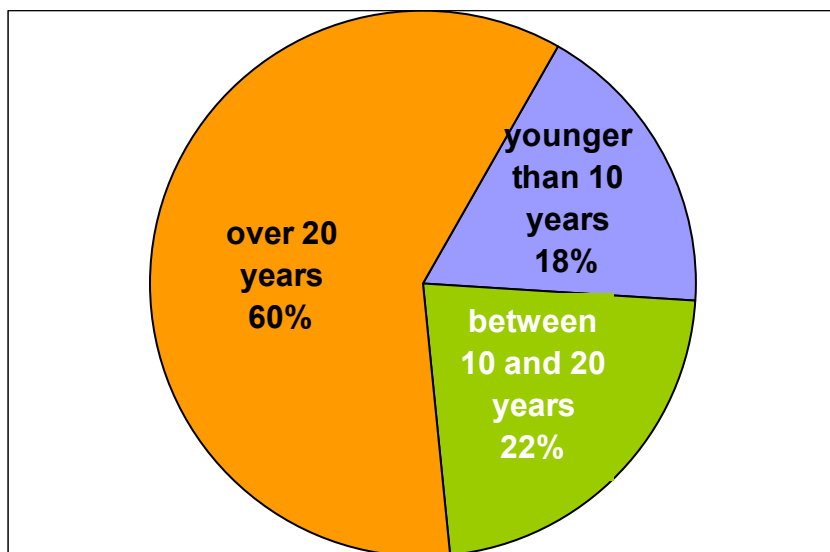


Table 8 – Age of generators by countries (% of capacity installed)

	Age of power plants (in MW)				
	younger than 10 (excluding hydro over 10MW)	between 10 and 20 (excluding hydro over 10MW)	over 20 (excluding hydro over 10MW)	Hydro over 10MW (in MW)	Hydro over 10MW (age, year in average)
<b>Albania</b>	0	0	1450		
<b>Armenia</b>	9,7	0	3088,8		
<b>Bulgaria</b>	890	200	8095		
<b>Croatia</b>	444	447	2804		
<b>Czech Republic</b>					
<b>Estonia</b>	215	0	3014		
<b>Georgia</b>	19,4	323,5	2590,5		
<b>Hungary</b>	1004	1866	5123		
<b>Kazakhstan</b>					
<b>Kyrgyz Republic</b>					
<b>Latvia</b>	120	0	2057		
<b>Lithuania</b>	21	0	6208		
<b>Moldova</b>	0	0	418	16	26
<b>Mongolia</b>	0	576	201,5		
<b>Poland</b>					
<b>Romania</b>	4089	2347	4774	5891	24
<b>Russia</b>					
<b>Slovakia</b>	910	1424	3577,9	2394,5	15
<b>Turkey</b>	7595	11861	8233		
<b>Ukraine</b>					
<b>Total</b>	15317,1	19044,5	51634,7		
<b>%</b>	17,8	22,1	60,0		

## 6. Adequate structure of reserve capacity

According to the given answers, countries, which are the members of the UCTE or will be in the near future are followed the UCTE rules, which determine exactly the measure of primary, secondary and tertiary reserve. Part of the other countries, specially those, in which there is a vertically integrated company contained generation, transmission, distribution and supply, there is no need to distinguish these different kind of reserves, because the vertically integrated company has the responsibility to supply all of the customers. In case of some countries, we do not have any information about the structure of the reserves.

Some remarks: (1) maybe we have to clarify better the different types of reserves; (2) if we examine, whether a country follow the rules of an international association (UCTE) or not, maybe we should note only this; (3) we should differentiate or determine the reserves according to international rules and above these rules.

Table 9 – Structure of reserve capacities by countries

	<b>Adequate reserve capacity</b>			
	<b>Primary</b>	<b>Secondary (spinning)</b>	<b>Tertiary (cold)</b>	<b>Black start</b>
<b>Albania</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Bulgaria</b>	<b>120</b>	<b>160</b>	<b>950</b>	<b>400</b>
<b>Croatia</b>	<b>0</b>	<b>425</b>	<b>300</b>	<b>0</b>
<b>Estonia</b>	<b>0</b>	<b>30</b>	<b>100</b>	<b>0</b>
<b>Georgia</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Hungary</b>	<b>50</b>	<b>680</b>	<b>585</b>	<b>400</b>
<b>Lithuania</b>	<b>600</b>	<b>200</b>	<b>800</b>	<b>0</b>
<b>Moldova</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Mongolia</b>	<b>0</b>	<b>140</b>	<b>165,7</b>	<b>0</b>
<b>Romania</b>	<b>150</b>	<b>600</b>	<b>700</b>	<b>500</b>
<b>Slovakia</b>	<b>40</b>	<b>250</b>	<b>100</b>	<b>n.a.</b>
<b>Turkey</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>700</b>

For countries, where the reserve capacity structure is not „appropriate”, it will be more difficult to introduce energy markets based on free supplier switching of customers and to create regional markets.

## 7. Entry barrier – electricity production prices

In this part of our study, we try to figure out whether the current (2002-2003) electricity producer prices in the ERRA countries are attractive enough to encourage investors to build new power plants or not. To collect the prices was not so hard, but the determination of the entry cost of a new power plant (gas turbine, CCGT, coal and nuclear) is very complex and difficult. It depends on a lot of parameter, for example the geographical region, the availability of the fuel, subsidies and the labour cost in the case of construction.

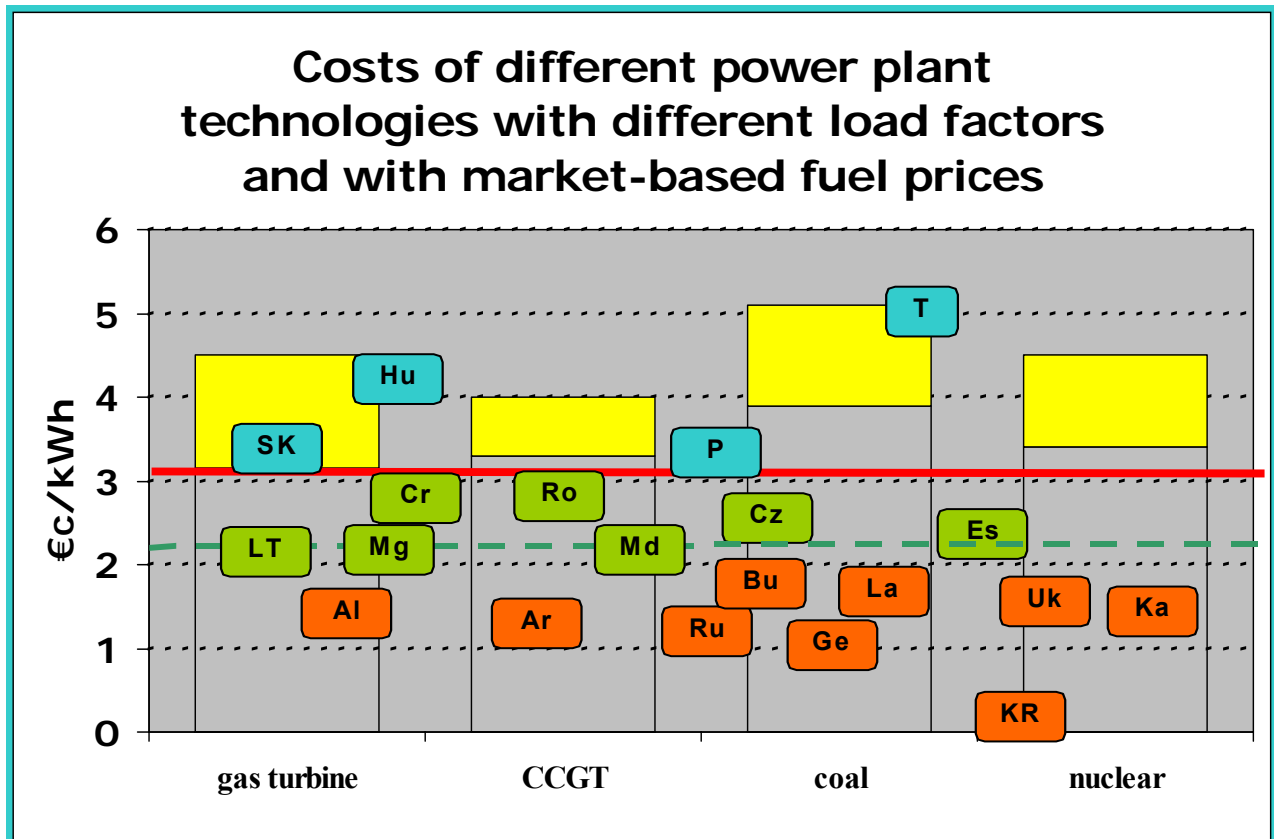
We can state, that the electricity producer prices are low in the ERRA countries. According to our determination of entry costs, only in Turkey, Hungary, Slovakia and Poland are the prices attractive for investors. We have to emphasise that the calculation of the entry cost is very insecure, so it would be necessary to determine the entry costs by country, and does not use a general one.

Table 10 – Electricity producer prices by countries

	<b>Electricity Producer Price (average of 2002-2003, excl. tax), EUR ¢/kWh</b>
<b>Turkey</b>	5,0
<b>Hungary</b>	4,2
<b>Slovak Republic</b>	3,2
<b>Poland</b>	3,1
<b>Croatia</b>	2,8
<b>Romania</b>	2,8
<b>Czech Republic</b>	2,6
<b>Estonia</b>	2,4
<b>Lithuania</b>	2,2
<b>Mongolia</b>	2,2
<b>Moldova</b>	2,2
<b>Bulgaria</b>	1,9
<b>Latvia</b>	1,8
<b>Ukraine</b>	1,6
<b>Kazakhstan</b>	1,4
<b>Albania*</b>	1,3
<b>Armenia</b>	1,2
<b>Russian Federation</b>	1,2
<b>Georgia</b>	1,0
<b>Kyrgyz Republic</b>	0,4
	2,2

Source: ERRA database

Figure 7 – Cost of different power plant technologies with different load factors and market –based fuel prices



Source: ERRA database

## 8. Depreciation, Maintenance, Investments

First of all, when we examine the investment, we try to determine whether the depreciation is used for maintenance and new investment.

We have very few data, but according to the given ones this principle is fulfilled in most of the responding countries. This means that network companies generally spend the financial source on maintenance and development, which is paid by customers through the network tariffs for this purpose (depreciation).

In many countries, this kind of monitoring is under preparation or because of the structure of the industry, it is hard to establish, for example in case of vertically integrated companies, where the asset value is determined for the whole company or there is cross financing among the activities.

Table 11 – Depreciation, maintenance and investments

	Depreciation of generation assets in million Euro	Maintenance of generation assets in million Euro	Net investment in generation in million Euro
<b>Albania</b>	n.a.	91 750	n.a.
<b>Armenia</b>	2,3	n.a.	5,0
<b>Bulgaria</b>	66,2	52,9	198
<b>Estonia</b>	17,4	n.a.	130
<b>Georgia</b>	8,9	50	25
<b>Hungary</b>	n.a.	68,9	480
<b>Lithuania</b>	36	31	n.a.
<b>Moldova</b>	1,4	1,4	n.a.
<b>Mongolia</b>	13 530	2 713	0
<b>Romania</b>	186,2	136,1	220,3
<b>Turkey</b>	37	31,5	1 079

## 8. Demand side solutions

In the previous sections we concentrated on the supply side of the issue of SoS, however solutions have to be found also on the demand side. More and more emphases are placed on the demand side when speaking about possible tools for ensuring SoS even in international fora, in particular as back-up (reserve) mechanism to be called upon in the case, when the market driven mechanisms and the different potential interventions do not work properly to ensure adequate capacity.

Implementation of DS solutions is initiated by the new electricity Directive (54/2003), in addition to this, a new proposal of a new Directive on the promotion of energy end-use efficiency and energy services was presented by the European Commission and currently is under consultation among stakeholders. The proposal includes provisions also concerning electricity demand, i.e. promotion of demand management and interruptible customers, and places obligations on suppliers and TSOs.

The IEA also launched a programme, which is called IEA Demand-Side Management Programme (IEA DSM) and which is an international collaboration with 17 IEA countries and the European Commission, working to clarify and promote opportunities for DSM. The Programme started in 1993, but it was revitalised in 2003 reinforced by the needs deriving from the developments of liberalisation. For the purposes of this Programme, DSM is defined to include a variety of purposes such as load management, energy efficiency, strategic conservation and related activities.

In our questionnaire we examined DSM tools like energy efficiency programs rate-design<sup>8</sup> and ripple control implemented in ERRA countries, and also considered the ratio of auto-production and distributed generation as tools that do not reduce the level of total demand, but concerns the demand on networks and may have influence on load management.

In many responding countries there are energy efficiency programs applied by the governments. Russia, Estonia and Croatia apply such governmental programs. In Latvia the state energy efficiency strategy includes the target of decreasing the primary energy consumption per GDP unit by 25% until 2010.

In Romania a separate agency is responsible for DSM and energy efficiency, which is the Romanian Agency for Energy Conservation (ARCE).

In accordance with the Lithuanian law, energy efficiency is the responsibility of the Energy Agency. Under instructions of the Ministry of Economy, Energy Agency deals with drafting the national Energy Program and other programs regarding the improvement of efficient use of energy resources.

In Hungary the interruptibility of customers are facilitated by the Commercial Code, however its effective implementation should be reinforced further. Ripple control is applied, as well, and governed by the Grid Code. In Hungary suppliers shift 600-800MW from peak period to off-peak period due to ripple control.

Hungarian government also implements energy efficiency programs, in the framework of which entities implementing energy efficient solutions may obtain subsidy. These programs are the following: National Energy Saving Program (grant of approximately 12 million EUR), Credit Fund for Energy Savings (credit for favourable interest rate of annually 4.8 million EUR), Phare co-ordinated credit construction for energy efficiency (credit for a favourable interest rate of annually a few million EUR), Program for the environmental-friendly energy management from 2004 until 2006 (grant of altogether 20 million EUR). There are no DSM programs applied in Slovakia, Albania and Armenia.

Our findings with regard to auto-production and distributed generation are shown in the Table 11 and Table 12.

Table 12

	<b>Below average</b>	<b>around average</b>	<b>over average</b>
<b>Autoproduction (Avg. 4.02%)</b>	<b>Al, Es, Ltv, Md, Mg, Ro</b>	<b>Bu, Hu</b>	<b>Sk, T</b>
<b>Distributed generation (Avg. 3.18%)</b>	<b>Al, Ar, Bu, Cr, Ltv, Ro, Ru</b>	<b>Hu, Mg, Ge</b>	<b>Sk, T</b>

<sup>8</sup> Rates to be paid by a customer per kWh differ according to the level of consumption, i.e. according to consumption bands. E.g. different rates are applied in the case of consumption below 10MWh, in the band between 10 and 20 MWh etc. (This solution is not applied in ERRA countries.)

Table 13

Country	Autoproduction in % of domestic generation capacity	Distributed generation (per total installed capacity, %)
Albania	0	0
Armenia	n.a.	0
Bulgaria	4,4	1,2
Croatia	n.a.	2,1
Estonia	1,17	n.a.
Georgia	n.a.	3,53
Hungary	4	3
Lithuania	1,25	0,3
Moldova	1,1	n.a.
Mongolia	0	2,8
Romania	1,58	1,5
Russia	n.a.	0
Slovakia	10,91	9,77
Turkey	15,8	14
Average	4,02	3,18

The increasing ration of distributed generation capacity (of total installed generation capacity) requires new consideration of the regulator regarding distribution charge setting regarding incentives on distributed network development. Strong distribution network could be able to “receive” the distributed energy.

### III. NETWORKS

As a general introduction we found more difficult to determine conditions, create indexes and collect information and data in case of the networks than in generation. However it is really important to have such an indexes because the network is as important as the generation to create an integrated market for electricity in Europe or a regional market among several countries, since congested network connections may hinder both trade in appropriate volume and assistance among national markets for supply security reasons.

## 1. Unbundling of TSO/ISO

Two of the main factors we examined, which may facilitate the necessary network developments in the case of congestion. One is the unbundling of TSO/ISO. The unbundling of the TSOs (ISO in Hungary) has happened in most of the ERRA countries. The more general one is the legal unbundling, but for example in Latvia only accounting unbundling was established.

## 2. Cost shares of electricity supply

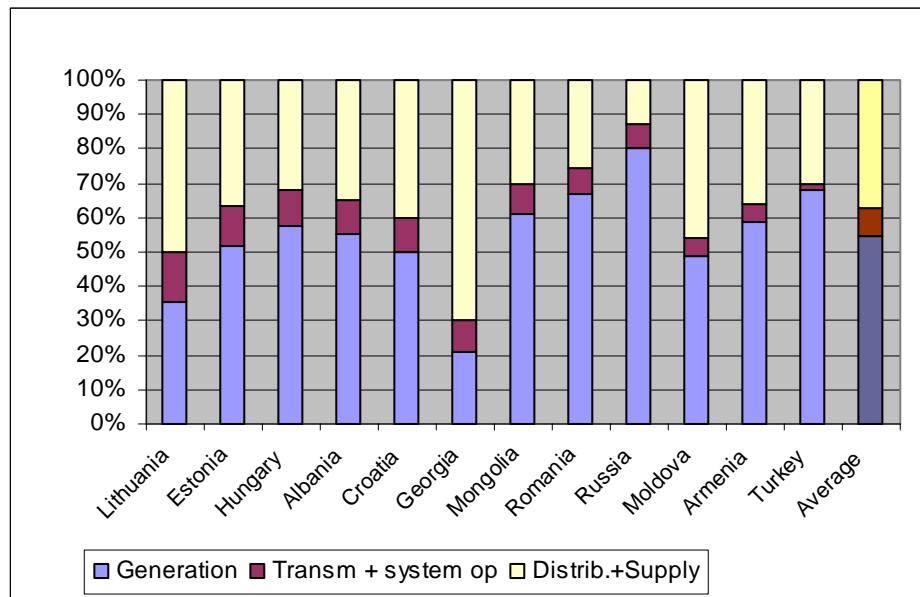
The other factor mentioned above is the sufficiently high (incentive) network charges. According to the basic principle we are going to study, transmission charges should be sufficient to cover network developments. Considering international experience, the necessary share of transmission charge including system operation charge is around 5-10% of all charges. Because in most of the ERRA countries, there is a TSO, we could examine the cost share of transmission and system operation together. The average share for transmission (including system operation) in the responding ERRA countries is 8,41%, which varies from 5% to 14%, and tells us that in principle the necessary investments can be done, since charges are sufficiently high in average. In a few cases these cost shares are artificial, because there is only one, big vertically integrated company who represents the electricity industry. In addition to this, it is also hard to determine these cost shares, if there is any kind of vertically integration among the companies (generation+transmission, transmission+supply, etc.).

Deeper analysis might be required by the fact that the border between transmission and distribution networks differs by countries. Our general finding was that 120 kV lines are considered as distribution lines in ERRA countries.

Table 14 – Average cost shares of electricity supply

	Average cost shares of electricity supply (%)		
	Generation	Transm + system op	Distrib.+Supply
<b>Lithuania</b>	35,7	14,3	50
<b>Estonia</b>	51,7	11,5	36,8
<b>Hungary</b>	57,3	10,5	32,2
<b>Albania</b>	55	10	35
<b>Croatia</b>	50	10	40
<b>Georgia</b>	21	9,5	69,5
<b>Mongolia</b>	61	9	30
<b>Romania</b>	66,7	7,5	25,8
<b>Russia</b>	80	7,5	12,5
<b>Moldova</b>	48,7	5,4	45,9
<b>Armenia</b>	58,97	4,86	36,17
<b>Turkey</b>	68	2	30
<b>Average</b>	54,51	8,51	36,99

Figure 8 – Average cost shares of electricity supply

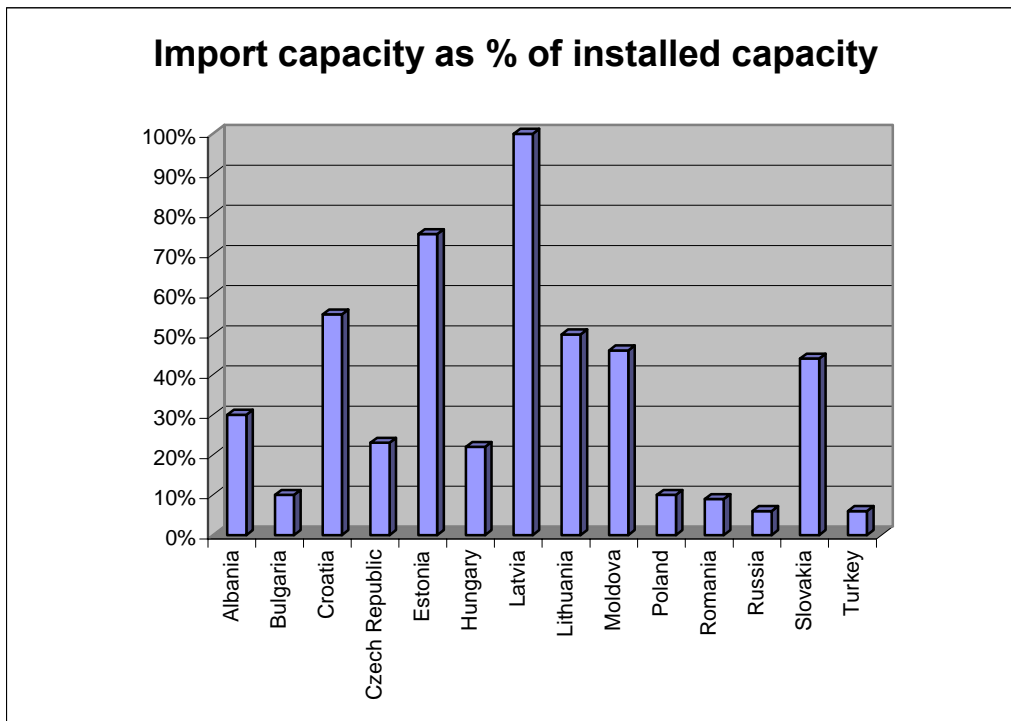


This analysis has not given an appropriate indication on the average size of network charges. In countries where the average end-user tariff is below the international averages or does not cover all the necessary cost elements, problems might occur concerning network developments to be covered through tariff even if the proportions of the certain components of the supply chain are “healthy”. Therefore deeper benchmarking analysis on transmission/ distribution charges would be wishful.

### 3. Interconnectors

The European Union has the strong intention to establish the internal electricity market through Europe. Most of the conditions with which the member states have to comply are contained in the Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC and the Regulation (EC) No. 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity. One of the most important conditions is to have enough cross-border capacity among the neighbouring member states. That is why the Commission suggests each country to have 10% import-export capacity according to the installed generation capacity of the country. This could be a healthy minimum requirement for the countries of this region in order to facilitate trade among national markets. The following diagram shows that almost all of the ERRA countries fulfil this requirement. We can even state, that ERRA counties have strong interconnections with each other and with the Western European network. (We have to note that the source of data on interconnections is the European Commission. System operators seem to have difficulties to provide only one number for cross-border capacity of the country. They explained us that numbers can be given for each border of a county; values (NTC ATC, etc.) cannot be added.)

Figure 9 – Import capacity as % of installed capacity



Source: 3<sup>rd</sup> Benchmarking report of European Commission

This shows that physical cross-border capacities are only necessary but not sufficient condition for the effective trade. Further analyses should be made on the intersection capacities already contracted (Already Allocated Capacity, AAC) and the capacities reserved by the TSOs for the not scheduled flows and events (Total Reserve Margin, TRM), which reduce the volume of commercial transactions (Available Transfer Capacity, ATC). Regulators should make efforts to understand the ATC calculation methods of TSOs, in particular, when the TSO is not effectively unbundled from other commercial companies.

#### 4. Features of network

We have very few data on this issue. We examined the length of the network. The average length in transmission is 1-3,5 km/1000 consumers. There is only one extreme example in the case of Mongolia, which is because of the low population and the huge distances within the country. Another aspect, we want to examine is the maintenance of the networks. In this case we also have very few data, which say that 2-3% of the asset value is used to maintain the transmission and the distribution networks. By analysing the amounts used for the maintenance of the networks, our aim was to determine to what extent one can expect the reliability and availability of networks.

## 5. Quality of supply – congestions, breakdowns

As we defined in the first part of this paper, reliability of the system is construed as an element of the issue of SoS to be included in this analysis. All costumers may expect to receive continuous supply of a relatively stabile and appropriate quality. The last questions of the questionnaire tried to map the frequency of technical congestion on lines of different voltage, the number of breakdowns on high and middle-voltage lines and some indices of supply quality like the System Average Interruption Frequency Index (SAIFI), the System Average Interruption Duration Index (SAIDI) and the Consumer Average Interruption Duration Index.

These indices are to be calculated as follows:

SAIFI= number of interruptions/ number of all customers

SAIDI= duration of interruptions (h)/ number of all customers

CAIDI= duration of interruptions (h)/ number of customers affected by the interruptions

Generally speaking, only few countries could give us effective answers as it is well reflected in the Table 15.

In may be resulted from the fact that quality of supply is/might not be monitored with these indices in more countries like e.g. in Albania, Armenia and Czech Republic. Another problem of comparing the data of countries that do measure QoS is that methods of measuring seem to be very different.

Despite all these obstacles we can state, that transmission network is reliable in general, since almost no internal congestions are experienced in Transmission lines.

In addition to the quantitative description of QoS situation in ERRA countries, it would be also useful to learn more about the procedures, how QoS is monitored, by whom, how are standards enforced, what sanctions are applied if any.

Table 15 – Quality of supply

	Number of technical congestions per year			Number of breakdowns per year (including both planned and forced breakdowns)		SAIFI: System Average Frequency Index (number of interruptions/total number of customer/year	SAIDI: System Average Interruption Duration Index (duration (h) of interruptions/ total number of customers/ year)	CAIDI: Customer Average Interruption Duration (duration of interruption (h)/number of affected customers/ year)
	over 400 kV	at 400 kV	below 400 kV	HV	MV			
Albania	not measured			not measured				
Armenia	not clear			not measured				
Bulgaria	0	0	0	696	39 840	1,233	4,71	7,12
Croatia	0	0	2	under preparation				
Czech Republic								
Estonia	0	0	0	18 000	18 000	under preparation/ not available yet		
Georgia	0	0	0					
Hungary	0	0	0	7 228	7 209	2,55	5,56	2,13
Kazakhstan								
Kyrgyz Republic								
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	0	0	0	0	13 492	0,57	1,28	n.a.
Moldova	0	0	0	n.a.	n.a.	n.a.	n.a.	n.a.
Mongolia	0	0	0	0	1 293	3,5-4	7-9	2-2,5
Poland								
Romania	0	0	0	11 538	48 364	3,41	n.a.	n.a.
Russia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	0	1	0	n.a.	n.a.	not measured	not measured	not measured
Turkey	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ukraine								

#### IV. FINANCIAL INDICATORS

It is important to analyse how profitable the certain segments of the value chain are, i.e. whether any development in generation and networks may be expected.

In the questionnaire we intended to collect several profitability, property and liquidity indices. These indices are the following:

Ratio of invested assets calculated as (Invested assets\*100)/ Total assets.

Equity ratio calculated as (Equity capital\*100)/Total liabilities.

Profit as a proportion of sales revenue, which is (Profit/loss of ordinary activities\*100)/Net revenue of sales.

Return on Assets, which equals (Earning after Tax\*100)/Total assets.

Return on Equity, which is calculated as (EAT\*100)/ Equity capital.

Liquidity index, which equals Current assets / Current debts payable.

Degree of indebtedness, which is (Long-term debts payable\*100)/(Equity + long-term debts payable)

In the current analysis - mostly due to the volume of answers – we focused on two indices: Profit as a proportion of sales revenue and Return on assets.

As it is shown in the Tables 16 and 17, companies of orange-coloured countries are below average, companies of blue-coloured countries are above average, and the ones of green-coloured countries are around average.

The better are the indices the more attractive the industry can be for investors. However, low indices may indicate the existence of a big state monopoly, thus with starting liberalisation it still can be attractive for investors.

Table 16 – Financial indicators

	Generation		Transmission		Distribution	
	Profit as a proportion of sales revenue = (Profit /loss of ordinary activities x 100)/Net revenue of sales	Return on assets = (Return after Tax x 100)/Total assets	Profit as a proportion of sales revenue = (Profit /loss of ordinary activities x 100)/Net revenue of sales	Return on assets = (Return after Tax x 100)/Total assets	Profit as a proportion of sales revenue = (Profit /loss of ordinary activities x 100)/Net revenue of sales	Return on assets = (Return after Tax x 100)/Total assets
Armenia	9,94	1,87	46,66	5,55	4,57	2,86
Bulgaria	0,03	0,01	0,08	0,08	distr.+transm. together	
Croatia	0,3	0,05	0,69	0,06	0,41	0,06
Georgia	n.a.	5	n.a.	7,5	distr.+transm. together	
Hungary	10,5	6,1	21,6	3,55	5,3	5,8
Lithuania	6,3	1,9	-12,4	-7,7	5,2	3,8
Moldova	6,1	-2,2				
Mongolia	1,96	0,48	0,09	0,03	1,31	1,3
Romania	7,87	-1,07	11,11	1,54	1,37	0,73
Slovakia	n.a.	n.a.	4,61	6,06		
Turkey			n.a.	-0,9	n.a.	2
Ukraine	n.a.	3,8				
Average	5,38	1,59	9,06	1,58	3,03	2,36

Figure17 - Profitability

Profit as a proportion of sales revenue = (Profit /loss of ordinary activities x 100)/Net revenue of sales			
	Generation	Transmission	Distribution
<b>Below average</b>	Bu, Cr, Mg	Bu*, Cr, LT, Mg	Cr, Mg, Ro
<b>Around average</b> (G: 5.4%; T: 9.1%; D: 3%)		SK, Ro	
<b>Above average</b>	Ar, Hu, LT, Md, Ro, Ge	Ar, Hu, Ge*	Ar, Hu, LT

\* D + T together

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**Special thanks to Ms. Denise Parrish, NARUC (USA) and Mr. Valeriy Tsaplin, NERC (Ukraine).**



This publication was made possible through support provided by the Energy and Infrastructure Division of the Bureau of Europe and Eurasia under the terms of its Cooperative Agreement with the National Association of Regulatory Utility Commissioners, No. EE-N-00-99-00001-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development or National Association of Regulatory Utility Commissioners.

ERRA Tariff/Pricing Committee:

## Performance Evaluation for Power Distribution Companies

### ISSUE PAPER

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- 2004 -

## ***I. Introduction***

Well-known theorems of welfare economics state that competitive mechanisms of a free market provide for economically efficient distribution of resources. However, in some cases, in particular, in the presence of a natural monopoly, market mechanisms become invalid, and state regulation becomes necessary for normal functioning of such markets. Namely, in the electricity sector natural monopolists are companies transmitting electricity through main and distribution electric networks. It is beneficial for the society to have just one company in the natural monopoly market. But in the absence of the competition press, a monopolist tries to maximize its profit by reducing volumes of production, increasing prices for goods and services, reducing their quality. The regulator should look after the monopolist to ensure quality of goods and services acceptable to the consumers at reasonable prices. The price should allow the monopolist to cover all necessary costs and at the same time to prevent him from getting revenues.

However, in principle, an exact regulatory definition of the regulated company's objectively necessary costs is impossible due to the information problem. Firstly, access to the information is asymmetric: the regulated company always knows much better than the regulator how close its costs are to optimal costs. Secondly, the information is not complete, as even the company itself, in the absence of competition, does not know what its potential for cost reduction is. The only possibility to assess efficiency of costs of a regulated company is to perform benchmarking analysis between this company and similar companies. The comparison can be done both with real companies and with models of an average or efficient company built on the basis of the complete sample of similar companies.

## ***II. Performance evaluation for power distribution companies***

The main performance indicators for a natural monopolist are measures of cost efficiencies. However, it would be wrong to assess efficiency only by the cost per unit of output, as costs might depend on many external (not controllable by the company) factors, such as geography, climate, density of the population, structure of consumption (share of industrial, rural, residential consumers), and also on the size of costs related to maintaining the reliability of the electricity supply (maintenance and upgrading of networks), ensuring meeting quality standards of services provided to consumers, and so on. That is why when evaluating company performance regulators usually consider many indicators of activities. In general, two categories can be identified – partial and general measures of performance.

### ***A. Partial (one-dimensional) measures of performance***

Partial (one-dimensional) productivity measures reflect output relative to a single input. They are relatively simple to calculate and interpret. Obviously, no single partial indicator can provide a complete measure of operational performance. If viewed in isolation, partial financial performance indicators can be misleading. For example, an improvement in labor performance (productivity) could reflect substitution of capital for labor, or a move to contracting out labor-intensive functions. This represents a regulatory danger as firms'

incentives could be altered in a possibly preserve fashion in order to affect the results of partial performance monitoring. Nevertheless, if a full range of partial productivity measures is considered, it can still provide a general impression of efficiency levels and rates of change.

Considering the electricity distribution business, partial performance indicators, such as MWh distributed per employee or minutes lost per customer, is the simplest way to perform comparisons between different companies. Clearly, these can provide important indicative information on relative performance which may suggest that a given network service provider could improve its performance in a particular way, such as reducing staff numbers. These kinds of measures appear in annual reports of companies and are commonly used by market analysts. The main drawback of partial measures is that they fail to account for the relationships among the different input and output factors. Basic financial ratios can also be used to evaluate the initial level of performance of distribution companies. The main purpose of these ratios is to observe the financial situation of distribution firms in order to monitor firms' future sufficiency and sustainability. One of the primary methods of evaluating how well a utility is performing financially can be measured by dividing net operating income by rate base to reach to the overall return (profit) level. Since the profit level is an enlightening indicator, it can be also used by regulators to assure that the utility is not earning at excessive (or very low) profit levels when a company is only allowed the opportunity to earn up to an authorized return. When the return is too low, the regulator may be concerned about the utility's ability to provide safe, adequate and reliable service.

Another primary indicator of how well a utility is performing for its equity shareholders is the return on equity level. This ratio can also be used by the utility itself to determine how well it is doing for its shareholders. Regulators must balance the interests of customers and shareholders when establishing a target return on equity. When determining an appropriate level, regulators must look at comparable earnings of companies with similar risk profiles. Once a target return is established, the regulator asks to get periodic reports to examine what the utility is earning compared to that target.

Monitoring capital expenditure trends is also very important in terms of distribution firms' financial sufficiency since trends of decreasing investment may indicate inability or unwillingness to borrow, inability to generate internal funds, or low cash flow. Sustainability also plays an important role in ensuring continuity of service supplied by distribution firms. One of the major indicators to assess firms' sustainability is its debt/equity ratio. Normal acceptable range for debt/equity ratio is 40% equity and 60% debt up to 60% equity to 40% debt. Since equity is generally more expensive than debt, at least in countries that have well-developed financial markets, too much equity costs ratepayers more than necessary. If there is too much debt, the cost of debt increases because there is an increased risk to the security holders that the utility will have difficulty meeting the interest and principal payments.

The uncollectible revenue ratio, not used extensively as a measure of financial viability and ranging between 1-2% for most of the utilities, is another important indicator for financial

performance evaluation. If the uncollectible revenue percentage becomes larger than normal, it may be an indication of an internal corporate or managerial problem. Therefore, regulators should look at the level of uncollectible revenues when determining rates to assure that only a normal, appropriate level is included.

Last but not least; times interest earned ratios, line losses, return on sales, sales efficiency (sales in term of values or quantity per employee), users' efficiency and some other methods can also be very helpful to be considered as internal and/or external benchmarks to reveal the financial performance of distribution firms. Some measures of efficiency of power distribution companies are presented in the table 1.

*Table 1. Some indicators of efficiency of power distribution companies*

<b>Cost Efficiency Indicators</b>
Cost of a unit of output
Operating costs per unit of output
Capital expenditures per unit of output
Operating costs per one kilometer of electricity transmission lines
Operating costs per consumer (by groups and classes)
<b>Indicators of Labor and Capital Productivity</b>
Net sale of electricity per employee a year
Revenue per employee a year
Net sale of electricity per 1 MV A of transformer capacity
Net sale of electricity per 1 km of electricity transmission lines
<b>Financial Indicators</b>
Asset, equity, operations, production profitability ratios
Duration of a commercial cycle
Level of payment for electricity
Receivables and payables
Share of bad debts
Commercial losses of electricity
<b>Technical Indicators</b>
System load ratio
Technical losses of electricity
Fixed asset upgrade ratio
Equipment utilization ratio
Number of equipment failures per 100 km of networks (or per 1 kWh)
<b>Indicators of Reliability and Quality of Services</b>
Technical indicators (standards of voltage, frequency, etc.)
Commercial losses (time of reconnection, repair, etc.)
Reliability indicators (indices of average frequency and duration of outages)

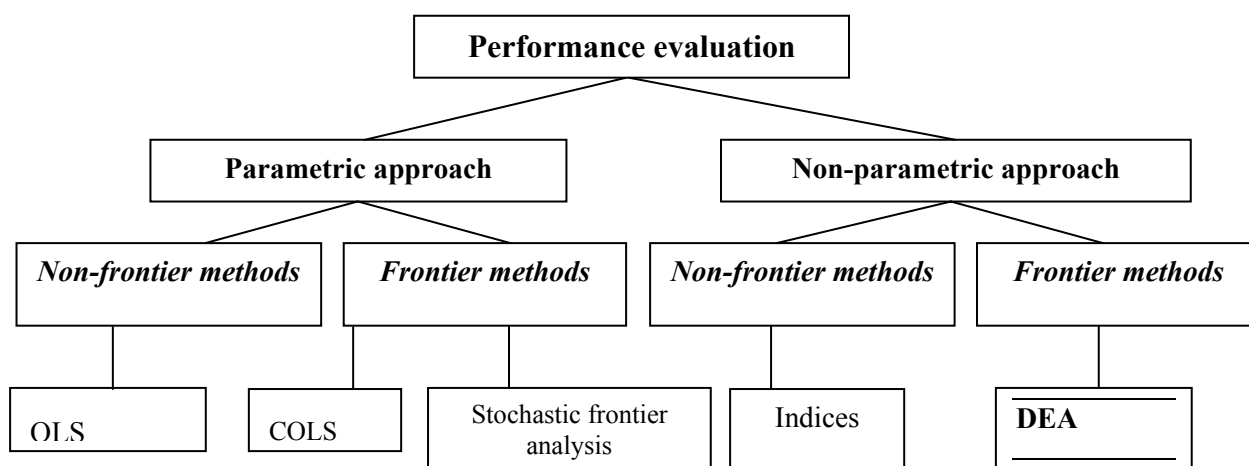
## B. General (overall) measures of performance

The nature of network service is characterized by multiple inputs and outputs. For example, the outputs may be the energy transported and the number of customers served using capital and labor as inputs.

Use of partial measures of performance allows certain conclusions to be made about certain aspects of company operations and dynamics of their changes, but except for special cases, does not allow for general (integrated) performance evaluation of the company as a complex system that depends on multiple factors, and does not allow for the development of groups of companies by their efficiencies. This problem can be solved using modern methods of analyzing productivity/efficiency, which allows for the evaluation of the general efficiency of the company taking into account multiple factors.

Efficiency analysis can be split into parametric and non-parametric, frontier and non-frontier methods.

Figure 1. Performance evaluation methods<sup>9</sup>



Parametric methods, for example, stochastic frontier analysis (SFA), are based on econometric analysis and require determination of the functional form of the company's production function (or cost, profit, revenue function). The advantages of the parametric methods include accounting for the impact of random noise, and factors that for some reason were not included in the model, in the resulting function. Non-parametric methods, for example, Data Envelopment Analysis, use mathematical programming and do not require determination of the form of the production function (cost functions, etc.), which is one of their main advantages in comparison with parametric methods.<sup>10</sup> Meanwhile, their main drawback is considered to be the absence of error vectors and sensitivity of results to the number of variables in the model (when the number of factors increases in the model, the number of firms on the efficiency frontier increases).

<sup>9</sup> Most common methods are presented in the figure.

<sup>10</sup> The first definition of the theory of efficiency and methodology (DEA) can be found in Farrell (1957), Fare and Lovell (1978) and, finally, Charnes, Cooper and Rhodes (1978).

The essence of the frontier efficiency analysis methods is that the efficiency of companies is evaluated with respect to the efficiency frontier, which is determined by the most efficient companies present in the selection (DEA, COLS, SFA methods). Unlike frontier methods, non-frontier analysis is based on a comparison with some average, in terms of selection level, determined by the calculation of indices or using the Ordinary Least Squares method (OLS). It is necessary to note that in regard to energy industry, , frontier methods -- both parametric and non-parametric (DEA, COLS, SFA) -- are most commonly used.

## i) Parametric methods of performance evaluation

**Regression analysis.** A well-known ordinary least squares (OLS) method allows for evaluation of an *average* production function or *average* cost function for the group (selection) of similar companies. As with all parametric methods, it requires determination of a functional form of simulated function. The general form of the model, for example, cost function (outlined in figure 3) is

$$C_i = f(Y_i, w, z, \beta) \exp(v_i),$$

where  $C_i$  = costs of firm  $i$  ( $i = 1, \dots, K$ )

$Y_i$  = output vector (product manufactured by firm  $i$ ),

$w$  = vector of prices on input production factors such as materials, capital, labor force, etc. (vector of input factors  $X_i$ ),

$\beta$  = vector of evaluated parameters,

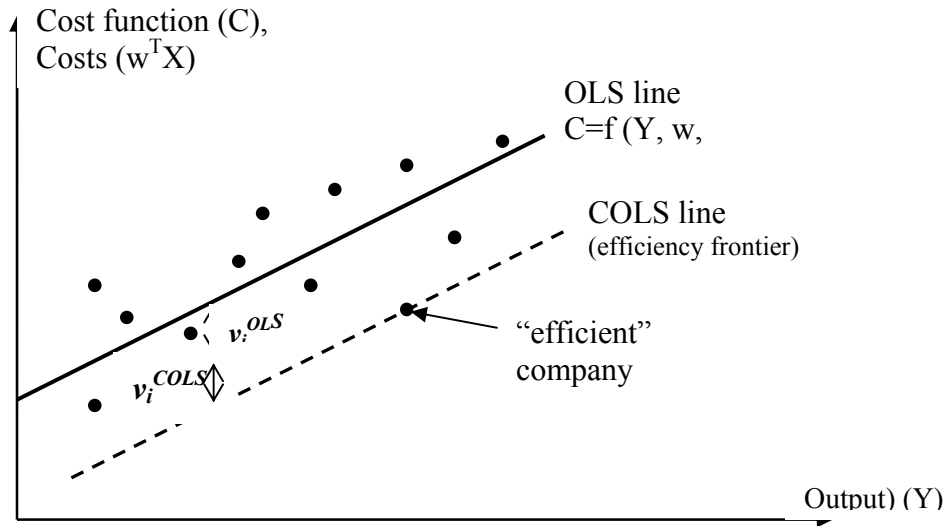
$z$  = external factors (for example, climate), and

$v_i$  = accidental error (random noise).

To measure the cost efficiency of a company, the difference between its actual costs and estimated average costs is used (value of the function of average costs when permutating volumes of production, prices of production factors and environmental factors for the given company). This method also allows for the evaluation of statistical relevance and the impact of factors included in the model on the size of the cost function. That is why it can be used to make decisions on reallocation of production factors, changes in the operational environment, etc. in accordance with the goals of the company.

**Method of Corrected Ordinary Least Squares (COLS)** is a frontier method, derived from the least squares method. It is assumed that at least one company in the selection is on the efficiency frontier: for the cost function it is the company with the highest negative value (estimate) of a random error (i.e.  $\min_j \{\hat{v}_j\}$ , where  $\hat{v}_j$  represents OLS measure of unknown random error  $\hat{v}_j, j = 1, \dots, K$ ). The OLS line (hyperplane) is corrected (shifted) to this value in such a way (see figure 2), that the COLS line (hyperplane) would cross the point that corresponds to the “efficient” company and would serve as an efficiency frontier for all other companies. Then for all other companies in the selection, deviations from the efficiency frontier are explained by inefficiency of a company:

Figure 2. Regression analysis: methods OLS and COLS - cost function



Efficiency factor 1 is assigned to the frontier company, and the efficiency factor of any other company  $i$  ( $i = 1, \dots, K$ ) is calculated by the formula

**Efficiency factor.**  $i$  (by costs)  $= \exp \{ \hat{v}_i - \min_j \{ \hat{v}_j \} \}$  ( $i, j = 1, \dots, K$ )

**Stochastic frontier analysis (SFA).** The general form of the SFA model (cost function) is:

$$C_i = f(Y_i, w, \beta) \exp(v_i + u_i),$$

where  $C_i$  = costs of firm  $i$ ,

$Y_i$  = vector of output factors,

$w$  = vector of prices for input production factors  $X_i$  of  $i^{\text{th}}$  company,

$\beta$  = vector of evaluated parameters, and

$v_i$  = random error with normal distribution (random noise).

A specific feature of the SFA approach that distinguishes it from an ordinary regression analysis is the introduction of  $u_i$ , a non-negative element that simulates the size of inefficiency. Calculation of this element and, thus, of efficiency ratios, is done with the help of specialized software packages, for example, Stata 8.0 or Frontier. The main advantage of this method is that it takes into account a certain type of random error and, at the same time, evaluates an inefficiency element.

As has already been mentioned, results of parametric methods can be sensitive to reference conditions, such as: model specification; selection of variables (input and output factors, environmental factors); and determination of distribution of random value and inefficiency element. Selection of a frontier firm is also of great importance for COLS models. That is why in recent years, non-parametric methods of efficiency analysis, namely DEA and indices, began to be widely applied alongside parametric methods.

## ii) Non-parametric methods of performance evaluation

**Indices.** The most frequently used tool for determining changes in economic values over time are indices. Various inflation indices are well-known: Retail price index, financial indices (Dow Jones index), and others. Total Factor Productivity (TFP) measures changes in the aggregate volume of manufactured product with respect to changes in the total volume of input.

$$TFP_{st} = \frac{(\text{input\_factor\_index})_{st}}{(\text{output\_factor\_index})_{st}}$$

where  $TFP_{st}$  is index of the total productivity factor for time periods  $s$  and  $t$ . Indices of input and output factors characterize changes in the volumes of use of input and output factors, correspondingly, in production when moving from period  $s$  to period  $t$ . In the simplest case with one input factor  $x_t, x_s$  and one output factor  $y_t, y_s$ ,  $TFP_{st}$  looks as follows:

$$TFP_{st} = \frac{y_t / y_s}{x_t / x_s}$$

To evaluate technologies with multiple input and output factors, TFP is calculated with the help of the Tornquist Index or Fisher Index<sup>11</sup>. Today the TFP index is successfully used to evaluate efficiency in the price formula using incentive methods for regulation of natural monopolies (RPI – X).

One more index that found its application in the area of natural monopoly regulation is the Malmquist productivity index (MPI)<sup>12</sup>, which also characterizes changes in the productivity of a company over time. This index can be broken down into components that characterize changes in the efficiency and changes in the technology in the period under consideration. In practice, calculation of MPI is done using efficiency ratios calculated by means of the DEA method.

**DEA (Data Envelopment Analysis).** One of the most popular efficiency analysis methods is the DEA method. It is widely used to analyze efficiency of industrial and agricultural firms, banks and medical institutions, schools and military divisions, universities and chains of stores.

DEA is a non-parametric frontier efficiency analysis method. In the course of analysis, an efficiency frontier is built based on the selection data, and relative efficiency ratios are determined with respect to this frontier<sup>13</sup>.

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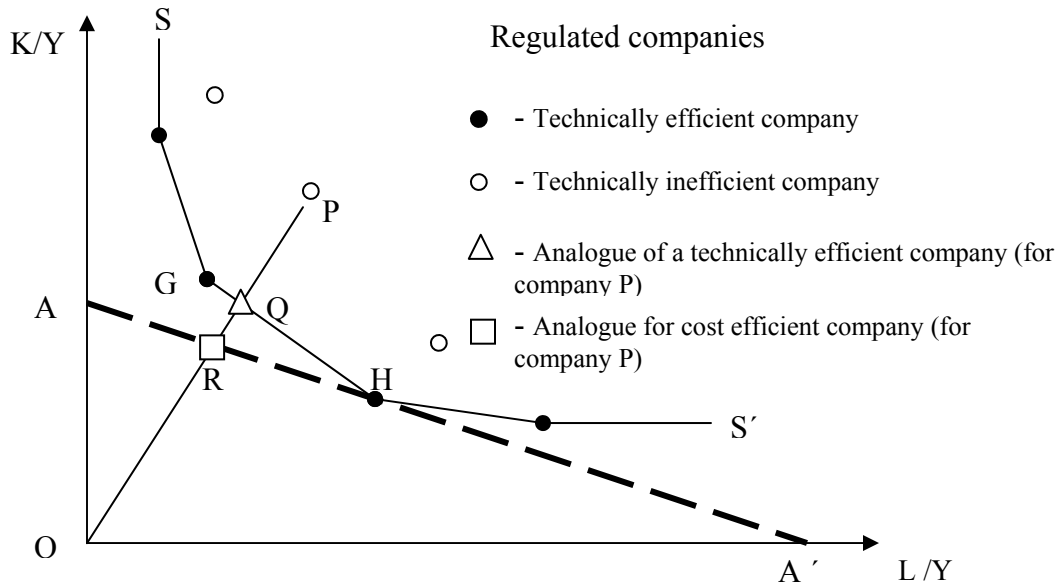
<sup>11</sup> See Coelli et. al (2002) pp. 69-93

<sup>12</sup> See Färe R., S. Grosskopf, M. Norris and Z. Zhang (1994).

<sup>13</sup> Formal mathematical description of the method one can find in Färe, R. And S. Grosskopf and C.A.K. Lovell (1994)

M. Farrell who proposed the idea of the DEA method in 1957 (Farrell, 1957) illustrated it graphically using as an example companies that use 2 production factors (for example, labor = L and capital = K) to manufacture one type of product = Y (Figure 3). The costs of labor and capital per unit of output are plotted along the axes of the graph (L/Y, K/Y).

Figure 3. Technical efficiency and allocative efficiency.



If to manufacture a unit of output a company uses a number of production factors (labor and capital) that corresponds to point P, then technical inefficiency can be represented (measured) by the segment QP. By this value, all production factors can be reduced without reducing the volume of production output. As a rule, technical efficiency of a company is calculated as a ratio:

$$TE = OQ/OP$$

The company is technically efficient if the ratio of its technical efficiency, TE, is equal to 1. If we know the correlation of production factor prices (determining line AA' in Figure 3), we can also calculate the efficiency of allocation of production factors (allocative efficiency), by the ratio:

$$AE = OR/OQ$$

Full economic efficiency (cost efficiency) is determined as:

$$EE = OR/OP$$

and is equal to product of technical and allocative efficiency:

$$EE = TE \times AE = (OQ/OP) \times (OR/OQ) = OR/OP$$

Advantages of the method include the ability to include in the model several input and output factors. Furthermore, the model does not require that one choose a functional form of production function or cost function, which significantly simplifies use of the method for practical purposes. Drawbacks of DEA include the assumption that there is a lack of errors in the reference data (more complicated versions of DEA require more detailed consideration to overcome this drawback).

### C. Use of efficiency analysis methods in regulating natural monopolies

Use of benchmarking regarding efficiency of natural monopolies is one of the ways to address the most complicated problems of regulation, namely, asymmetry and incompleteness of information. These methods allow evaluation of the optimal level of costs necessary to carry out monopolistic activities and possible reduction of a company's costs. That is why the efficiency analysis methods are widely used by energy regulators in many countries (table 2). In some countries, the use of efficiency analysis methods is included in the official pricing procedure (UK, the Netherlands, Norway and others). In other countries (Finland), they serve as an additional source of information when a regulator makes decisions on the level of tariffs for the company. Quite often, these methods are used by independent consultants that take part in the process of revising tariffs for services provided by natural monopolies.

*Table 2. Use of benchmarking methods by energy regulators*

Country	Use of benchmarking methods in energy regulation	Used benchmarking methods
<b><i>Europe</i></b>		
Austria	The issue is under consideration	Decision is pending
Belgium	the same	the same
UK	are used	TFP, DEA, COLS
Hungary	Used in certain limits	Is used by independent consultants when verifying justified nature of costs
Denmark	is used	DEA
Ireland	Is proposed to be use as an auxiliary factor	
Spain	is used	Theoretical model of an ideal firm (engineering-economic analysis)
Italy	the same	
Netherlands	the same	DEA
Portugal	The issue is under consideration	
Northern Ireland	is used	DEA and econometric methods
Finland	It is planned to be used to determine the rate of return	DEA is used as an auxiliary method
France	The issue is under consideration	

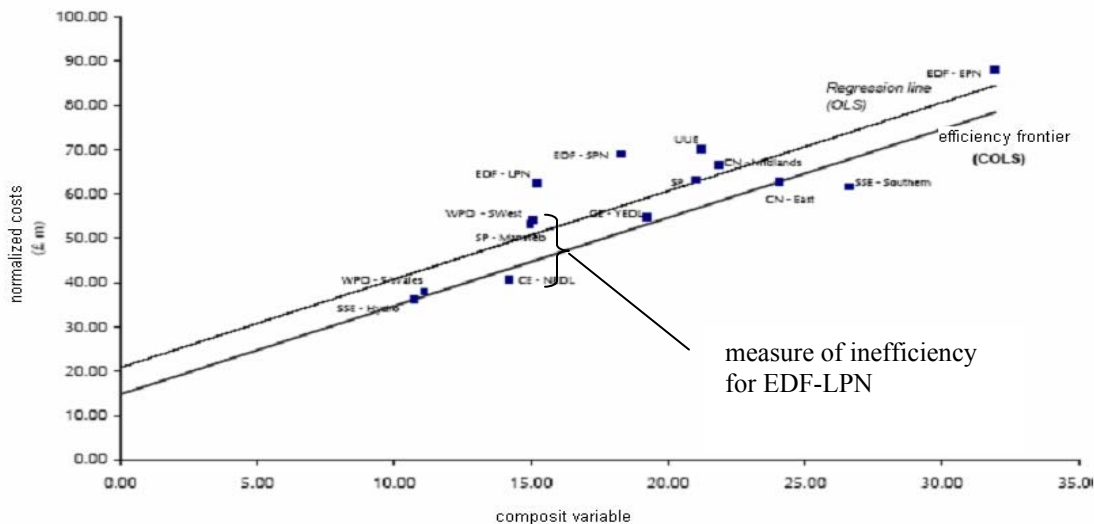
Sweden	is used	DEA and TFP to control costs, but not to regulate tariffs
<b><i>North America</i></b>		
Canada (Ontario)	is used	TFP
<b><i>South America</i></b>		
Brazil	is used	DEA
Chile	the same	Theoretical model of an ideal firm (engineering-economic analysis)
Columbia	is used	DEA
<b><i>Australia</i></b>		
Quinceland	is used	CFA, econometric methods, particular and aggregate productivity factors
New South Wales	the same	DEA, TFP, particular and aggregate productivity factors
Tasmania	the same	Used by independent consultants

In recent years many countries moved from traditional rate of return-based regulation (or other cost based methods of regulation) to incentive methods of regulation, such as price cap regulation and revenue caps.. The idea of these methods is that the regulator sets for a 3 – 5 year period a formula to change tariffs (revenues) of a regulated company:  $(RPI - X)$ , where RPI is inflation index (retail price index), and X is an efficiency factor that takes into account forecasted increases in efficiency for the regulated company. If during the year the company reduces costs for the value that exceeds X, all savings remain at its disposal.

Thus, the company is motivated to improve efficiency and reduce costs, and consumers are protected against growing prices for services provided by natural monopolies. Incentive regulation provides for partial solution of asymmetric information. Having economic incentives to reduce costs, during the period between tariff revisions, the company uses hidden reserves to reduce costs, thus, bringing its costs closer to optimal costs. At the time of a subsequent tariff revision, the regulator has more accurate information on the objectively necessary level of costs of the regulated company.

Benchmarking also provides the regulator with valuable information, in the case of using a traditional method of regulation – (costs plus), but when using incentive methods of regulation it becomes indispensable, as the efficiency factor X in the formula  $(RPI - X)$  is determined with the help of efficiency analysis methods. Efficiency analysis is made on the basis of DEA, COLS, SFA and other methods described above. Depending on specific conditions, various methods are used in different countries.

Fig. 4. COLS estimation of efficiency for UK electricity distribution companies



COLS method (figure 4) is used for this purpose in the UK. Due to the insignificant number of distribution companies, the Ordinary Least Squares method (OLS) is used to evaluate an average cost function with one compound variable, where the length of power transmission line is taken with the weight of 50%, and the volume of distributed electricity and the number of consumers each with the weight of 25%. The distance between the efficiency frontier and the point corresponding to the company is the company's inefficiency.

#### D. Performance evaluation of Ukrainian power distribution companies (Oblenergo)<sup>14</sup>

In comparison with many countries Ukraine has more favorable conditions for applying efficiency analysis methods. Being second largest among European countries with a transitional economy, Ukraine does not have drastic economic and climatic differences. The existence of a significant number of homogeneous enterprises with various forms of ownership allows for successful use of quantitative (statistical methods and mathematical programming) methods of analyzing the efficiency of natural monopolies. In the UK, there are only 14 power distribution companies; that is why the British energy regulator Ofgem has to benchmark using the COLS method with a limited number of accountable factors and is unable to use the SFA method that requires having a larger number of companies in the selection. The fact that in Ukraine there are about 30

<sup>14</sup> In this chapter we partially used results of research carried out in 2003 in the Public Utility Research Center, University of Florida (U.S.) by V. Tsaplin together with the Director of the Center Professor S. Berg and specialist of this Center C. Lin. The work was done in the framework of the FSA Contemporary Issues Fellowship Program.

power distribution and about 40 gas distribution companies allows the use of most of the efficiency analysis methods.

To verify the applicability of efficiency analysis methods to power distribution companies in Ukraine (Oblenergo), preliminary research was carried out of the efficiency of Oblenergo using DEA and SFA methods. Data for 24 companies for the period 1998-2002 were analyzed.<sup>15</sup> Six companies presented in the selection were privatized in 1998 (their codes are listed in table 4 as 201-206), five more companies (301-305) were privatized in 2001, and the remaining 13 companies (101-113) are still state owned.

To determine the specifications of the models, input and output variables in 20 research works devoted to efficiency analysis of power distribution companies using the DEA method<sup>16</sup> were reviewed. Volumes of distributed electricity, number of consumers and service area are most frequently used as output factors. Correspondingly, the most frequently used input factors are operating costs, number of employees, capacity of transformers, and length of electricity transmission lines. Taking into account this data, the main Model 1 will consider one input factor (operating costs) and three output factors: volume of distributed electricity, number of consumers and length of lines (Table 3). In Model 2, accepted output factors are the volume of distributed electricity and the number of consumers, and the input factors are the length of electricity transmission lines, the capacity of transformers, and the volume of electricity received in the networks. In this case, the length of lines and capacity of transformers take into account the use of capital, and the volume of electricity received in the networks accounts for network losses, as it is equal to the sum of distributed electricity and network losses. With an increased number of variables in the DEA model, the number of companies on the estimated efficiency frontier increases; that is why simplification of specifications allows for better evaluation of relative efficiency. To analyze the dynamics of changes in efficiency, data for the years 1998-2002 was combined and the DEA model was assessed with the common efficiency frontier for five years. Thus, the same company in different years is treated as different companies. When using operating costs, the level of inflation was taken into account.

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<sup>15</sup> We have excluded two city companies to achieve more homogeneity in the sample and to avoid the need to include additional variables. The third (regional) company was excluded due to its bankruptcy.

<sup>16</sup> Jamasb, T., Pollitt, M. (2002) "International Utility Benchmarking and Regulation: An application to European Electricity Distribution Companies", DAE Working Paper No.0015, Department of Applied Economics, University of Cambridge

Table 3. Specification of models for DEA analysis of Oblenergo

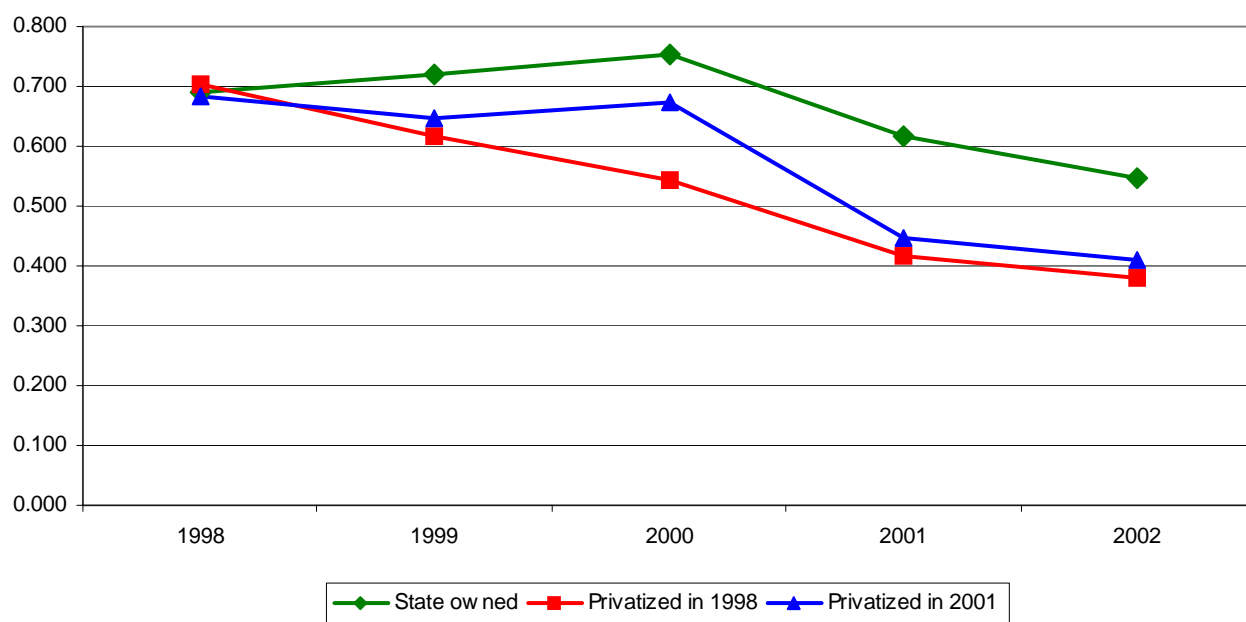
	Model 1	Model 2
Input factors	Operating costs of transmission, thousand hrivnas	Electricity received in networks, MWh
		Operating costs of transmission, thousand hrivnas
		Total capacity of transformers, MVA
Output factors	Volume of transmitted electricity, MWh	Volume of transmitted electricity, MWh
	Number of consumers	Number of consumers
	Length of electricity transmission lines, km	

Results of the efficiency analysis of oblenergo using the DEA method for models 1 and 2 are presented in Tables 4 and 5 and in Figures 5 and 6. As one can see from Figure 4, privatized companies in Ukraine are less cost efficient than state owned companies.

Table 4. Efficiency scores of state owned and privatized oblenergo for 1998-2002 (DEA, Model 1)

1998		1999		2000		2001		2002	
Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator
203	0.951	103	1.000	101	1.000	103	0.901	103	0.889
113	0.885	101	0.950	113	0.973	104	0.858	101	0.736
111	0.859	113	0.870	103	0.914	101	0.839	104	0.687
204	0.836	109	0.823	111	0.890	111	0.683	111	0.615
302	0.822	111	0.814	302	0.794	113	0.641	108	0.604
104	0.757	302	0.789	108	0.786	110	0.633	303	0.509
110	0.726	110	0.709	303	0.760	106	0.607	113	0.503
102	0.688	102	0.691	110	0.753	303	0.561	105	0.493
108	0.681	204	0.679	102	0.736	108	0.540	110	0.481
202	0.654	108	0.677	106	0.688	105	0.537	106	0.473
109	0.652	203	0.671	109	0.666	305	0.485	107	0.469
201	0.650	104	0.662	305	0.645	102	0.480	305	0.440
301	0.624	303	0.658	201	0.645	202	0.465	102	0.439
305	0.606	106	0.657	104	0.642	107	0.455	201	0.435
107	0.597	201	0.632	206	0.628	206	0.452	206	0.432
205	0.592	206	0.613	301	0.627	109	0.434	302	0.417
105	0.576	305	0.611	105	0.606	205	0.434	202	0.412
206	0.546	301	0.593	112	0.552	201	0.424	205	0.410
112	0.488	304	0.586	304	0.545	302	0.421	112	0.405
		202	0.575	203	0.541	204	0.396	204	0.370
		105	0.540	204	0.529	112	0.393	304	0.362
		205	0.522	107	0.514	304	0.392	109	0.333
		107	0.516	202	0.511	301	0.377	301	0.328
		112	0.448	205	0.408	203	0.335	203	0.230

Figure 5. Dynamics of cost efficiency of state owned and private oblenergo. 1998-2000. DEA, model 1

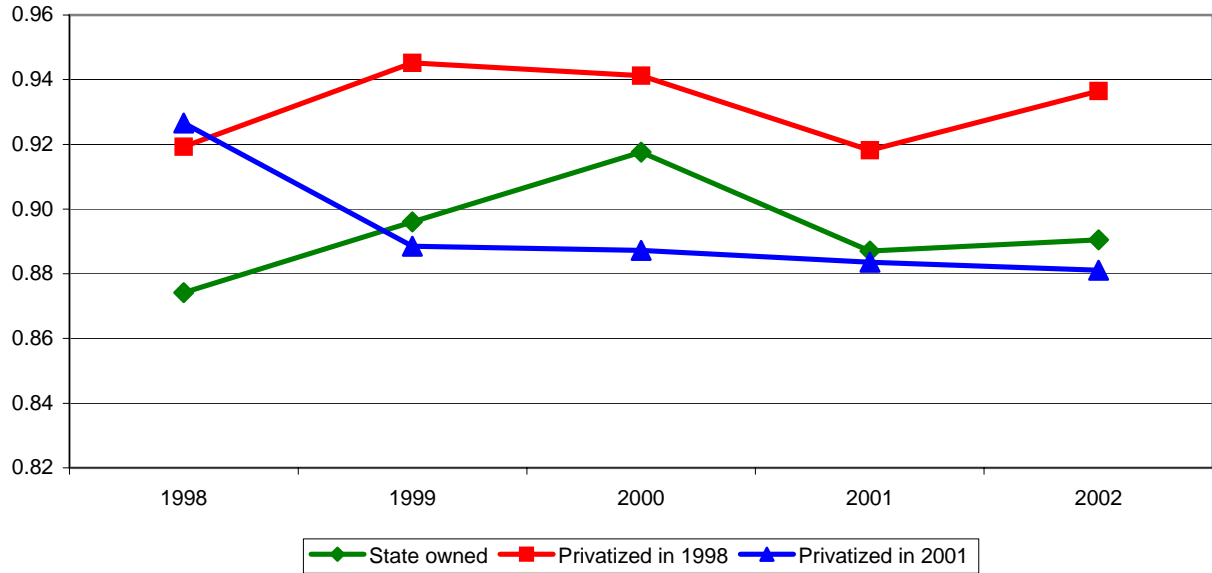


Inclusion of a variable «network losses» in model 2 (Figure 6) led to approximately equal estimates of efficiency of state owned and private companies.

*Table 5. Efficiency scores of state owned and privatized Obenergo for 1998-2002 (DEA, Model 2)*

1998		1999		2000		2001		2002	
Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator
<b>201</b>	1.000	<b>103</b>	1.000	<b>101</b>	1.000	<b>103</b>	1.000	<b>201</b>	1.000
<b>113</b>	0.976	<b>101</b>	1.000	<b>201</b>	1.000	<b>201</b>	0.995	<b>203</b>	0.996
<b>203</b>	0.972	<b>201</b>	0.990	<b>103</b>	0.998	<b>203</b>	0.978	<b>205</b>	0.994
<b>205</b>	0.946	<b>203</b>	0.973	<b>109</b>	0.994	<b>110</b>	0.971	<b>103</b>	0.992
<b>104</b>	0.934	<b>113</b>	0.957	<b>203</b>	0.975	<b>101</b>	0.961	<b>109</b>	0.990
<b>305</b>	0.931	<b>304</b>	0.956	<b>104</b>	0.953	<b>109</b>	0.955	<b>101</b>	0.959
<b>109</b>	0.925	<b>204</b>	0.952	<b>110</b>	0.952	<b>205</b>	0.955	<b>110</b>	0.952
<b>302</b>	0.925	<b>106</b>	0.946	<b>204</b>	0.948	<b>104</b>	0.934	<b>302</b>	0.939
<b>301</b>	0.924	<b>205</b>	0.945	<b>113</b>	0.938	<b>113</b>	0.916	<b>113</b>	0.933
<b>204</b>	0.914	<b>104</b>	0.935	<b>205</b>	0.933	<b>204</b>	0.914	<b>305</b>	0.926
<b>110</b>	0.904	<b>109</b>	0.935	<b>106</b>	0.933	<b>302</b>	0.911	<b>104</b>	0.923
<b>102</b>	0.904	<b>302</b>	0.927	<b>105</b>	0.931	<b>305</b>	0.910	<b>204</b>	0.921
<b>105</b>	0.893	<b>301</b>	0.917	<b>302</b>	0.929	<b>106</b>	0.892	<b>202</b>	0.896
<b>202</b>	0.886	<b>202</b>	0.915	<b>301</b>	0.927	<b>304</b>	0.887	<b>102</b>	0.894
<b>111</b>	0.863	<b>105</b>	0.909	<b>202</b>	0.920	<b>202</b>	0.886	<b>106</b>	0.887
<b>107</b>	0.811	<b>102</b>	0.899	<b>305</b>	0.907	<b>102</b>	0.882	<b>301</b>	0.879
<b>206</b>	0.797	<b>110</b>	0.895	<b>102</b>	0.900	<b>301</b>	0.857	<b>304</b>	0.877
<b>108</b>	0.793	<b>206</b>	0.894	<b>111</b>	0.896	<b>303</b>	0.854	<b>111</b>	0.850
<b>112</b>	0.739	<b>305</b>	0.881	<b>304</b>	0.873	<b>105</b>	0.852	<b>112</b>	0.840
		<b>111</b>	0.853	<b>206</b>	0.872	<b>111</b>	0.845	<b>105</b>	0.824
		<b>107</b>	0.815	<b>107</b>	0.815	<b>108</b>	0.785	<b>206</b>	0.812
		<b>108</b>	0.763	<b>112</b>	0.810	<b>206</b>	0.781	<b>108</b>	0.787
		<b>303</b>	0.762	<b>108</b>	0.807	<b>112</b>	0.780	<b>303</b>	0.784
		<b>112</b>	0.741	<b>303</b>	0.799	<b>107</b>	0.759	<b>107</b>	0.747

Figure 6. Dynamics of efficiency of state owned and private oblenergo.  
1998-2002. DEA model 2



To check the sensitivity of the results of the DEA analyses to the model specifications the SFA method was used. The preliminary research to assess the efficiency of costs of the companies used a log linear model of cost function. Model specification (Battese and Coelli, 1995):

$$\ln OPEX_i = \beta_0 + \beta_1 \ln OUTPUT_i + \beta_2 \ln WAGE_i + \beta_3 \ln CAPITAL_i + (V_i + U_i),$$

where

$OPEX_i > 0$  = operating costs of  $i^{th}$  company, thousand hrivnas (in prices of 2002);

$OUTPUT_i > 0$  = volume of distributed electricity, GWh;

$WAGE_i > 0$  = average wage, thousand hrivnas (in prices of 2002);

$CAPITAL_i > 0$  = capacity of transformers divided by the cost of fixed assets (proxy for the cost of capital), thousand hrivnas (in prices of 2002);

$V_i$  = random errors with normal distribution  $N(0, \sigma_v^2)$ ,

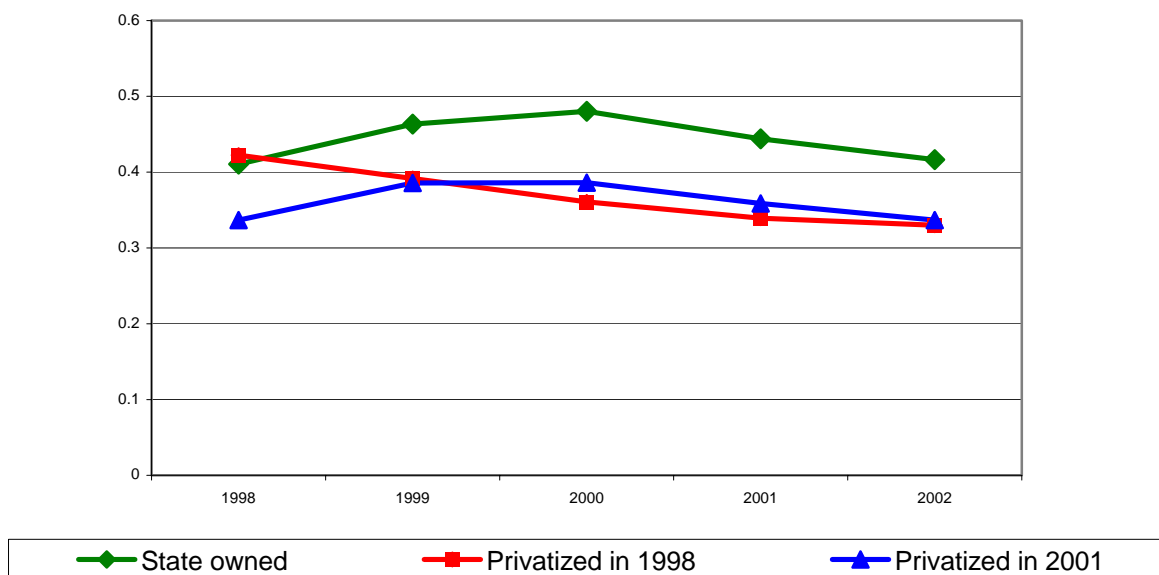
$U_i$  = non-negative random values (not correlating with  $V_i$ ) which simulate inefficiency of costs, with distribution  $N^+(\mu_i, \sigma_u^2)$ , where  $\mu_i = z_i \delta$ ;  $z_i - 3 \times 1$  is vector of variables, which can affect companies' efficiency – type of ownership ( $z_1$ ), density of consumer distribution ( $z_2$ ), and density of electricity consumption ( $z_3$ ); and  $\delta - 1 \times 3$  is vector of evaluated parameters.

Results of the efficiency analysis of Oblenergo using the SFA method are presented in Table 6 and in Figure 7.

Table 6. Efficiency scores of state owned and privatized oblenenergo for 1998-2002 (SFA)

1998		1999		2000		2001		2002	
Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator
<b>104</b>	0.642	<b>103</b>	0.946	<b>103</b>	0.997	<b>103</b>	0.998	<b>103</b>	0.948
<b>203</b>	0.640	<b>113</b>	0.676	<b>113</b>	0.751	<b>104</b>	0.734	<b>104</b>	0.642
<b>113</b>	0.635	<b>104</b>	0.626	<b>104</b>	0.700	<b>113</b>	0.648	<b>113</b>	0.601
<b>204</b>	0.449	<b>203</b>	0.566	<b>302</b>	0.490	<b>302</b>	0.424	<b>302</b>	0.453
<b>102</b>	0.401	<b>101</b>	0.522	<b>101</b>	0.488	<b>101</b>	0.422	<b>101</b>	0.420
<b>105</b>	0.398	<b>302</b>	0.487	<b>203</b>	0.481	<b>203</b>	0.422	<b>203</b>	0.393
<b>108</b>	0.395	<b>102</b>	0.424	<b>102</b>	0.447	<b>108</b>	0.412	<b>108</b>	0.388
<b>201</b>	0.383	<b>108</b>	0.401	<b>108</b>	0.436	<b>102</b>	0.401	<b>105</b>	0.369
<b>202</b>	0.365	<b>105</b>	0.401	<b>105</b>	0.412	<b>105</b>	0.391	<b>206</b>	0.367
<b>206</b>	0.349	<b>303</b>	0.396	<b>303</b>	0.396	<b>303</b>	0.378	<b>102</b>	0.360
<b>205</b>	0.348	<b>206</b>	0.395	<b>206</b>	0.382	<b>206</b>	0.368	<b>112</b>	0.344
<b>107</b>	0.347	<b>304</b>	0.395	<b>301</b>	0.367	<b>304</b>	0.353	<b>202</b>	0.338
<b>301</b>	0.341	<b>204</b>	0.384	<b>202</b>	0.364	<b>202</b>	0.348	<b>303</b>	0.333
<b>109</b>	0.338	<b>202</b>	0.375	<b>304</b>	0.363	<b>301</b>	0.329	<b>301</b>	0.324
<b>110</b>	0.336	<b>109</b>	0.366	<b>110</b>	0.352	<b>112</b>	0.312	<b>204</b>	0.322
<b>305</b>	0.332	<b>110</b>	0.359	<b>204</b>	0.348	<b>111</b>	0.311	<b>205</b>	0.299
<b>111</b>	0.323	<b>106</b>	0.349	<b>107</b>	0.345	<b>305</b>	0.309	<b>304</b>	0.295
<b>112</b>	0.289	<b>107</b>	0.348	<b>106</b>	0.342	<b>204</b>	0.308	<b>111</b>	0.295
		<b>301</b>	0.345	<b>112</b>	0.336	<b>205</b>	0.304	<b>305</b>	0.277
		<b>205</b>	0.330	<b>111</b>	0.321	<b>107</b>	0.303	<b>110</b>	0.275
		<b>111</b>	0.316	<b>305</b>	0.316	<b>106</b>	0.297	<b>106</b>	0.271
		<b>305</b>	0.305	<b>109</b>	0.313	<b>201</b>	0.285	<b>107</b>	0.268
		<b>201</b>	0.300	<b>201</b>	0.299	<b>110</b>	0.282	<b>201</b>	0.261
		<b>112</b>	0.292	<b>205</b>	0.292	<b>109</b>	0.260	<b>109</b>	0.236

Figure 7. Dynamics of cost efficiency of state owned and private oblenergo. 1998 -2002. Stochastic frontier analysis



According to the obtained results, on average, state owned companies are more cost efficient than privately owned companies. In addition, the ratio in the presence of a variable “structure of ownership” has a positive sign, which means that privatization on average leads to an increase in cost inefficiency; and that is why, on average, costs of privatized companies are higher than they might have been if these companies would have remained in the ownership of the state. Thus, results of the cost efficiency analysis by the SFA method in terms of quality are close to the results obtained using the first DEA model.

The results of preliminary research of efficiency of Ukrainian power distribution companies confirm the applicability of the discussed methods of analysis for Oblenergo performance evaluation.

Though the models used need to be improved, the results of two independent methods of analysis (parametric – SFA and non-parametric - DEA) are rather close in terms of quality and meet all expectations. Indeed, according to the theory of economic regulation, cost methods of regulation push regulated companies to increase costs. It is a well-known fact that state owned and private companies show different patterns of behavior. Private companies are more motivated and more successful in achieving goals set by their owners than state owned companies. That is why, as the results of SFA analysis and model 1 DEA show, they more efficiently increase costs (thus, increasing the value of companies). On the other hand, they are more efficient than the state owned companies in reducing network losses (according to the results of analysis of model 2 DEA). Obtained results to a major extent coincide with the results of research of the impact of privatization and types of regulation on the efficiency of energy companies in Spain<sup>17</sup>. They attest that cost methods

<sup>17</sup> Arocena , P., and K. Waddams Price (2002) Generating efficiency economic and environmental regulation of public and private electricity generators in Spain, International Journal of Industry Organization 20, 41-49.

of regulation that motivate increases in costs of natural monopolies are unacceptable, at least, for price regulation of private companies, which are more efficient when using incentive regulation methods. At the same time, it might still be reasonable to apply regulation on cost elements for companies that are still owned by the state.

## E. International benchmarking of power distribution companies

Quite often due to the insufficiency of the size of selection (for example, for main line operators), regulators use international benchmarking of performance evaluation (international benchmarking). This method also allows for a determination of the comparative efficiency of distribution companies in different countries. However, use of international benchmarking associated with a number of problems. In particular, it is more difficult to use cost factors (operating and capital costs, prices, commodity output, etc.), as in different countries the purchasing power of money differs, as well as the correlation of prices of different goods and services. To some extent this can be overcome by using the purchasing power parity of currencies of different countries. Thus, an evaluation was carried out comparing the efficiency of 24 Ukrainian and 7 British distribution companies (Manweb, Northern Electricity, Norweb, Southern Electric, SWALEC, Western Power Distribution, Yorkshire Electricity) for year 2000 using model 1 DEA. Operating costs were restated taking into account the purchasing power parity of Ukrainian hryvna and the British pound.

*Table 7. Efficiency indicators of 24 Ukrainian and 7 British companies for Model 1 DEA. Year 2000*

Company	Efficiency indicator	Company	Efficiency indicator	Company	Efficiency indicator
101	1.000	206	0.670	304	0.530
113	1.000	109	0.670	202	0.520
103	0.990	305	0.650	203	0.520
111	0.890	201	0.640	YEL(UK)	0.520
108	0.830	105	0.620	204	0.520
303	0.800	301	0.620	NEL(UK)	0.440
302	0.770	SEL(UK)	0.600	SWA(UK)	0.440
110	0.750	112	0.590	NWB(UK)	0.420
102	0.740	MAN(UK)	0.560	205	0.410
106	0.690	107	0.550	WPD(UK)	0.390

To avoid the aforementioned problems in the course of international benchmarking, many researchers suggest applying input and output factors only in physical (and not in value) terms (number of personnel, length of networks, capacity of transformers, volume of electricity, etc.).

### **III. Quality assessment of consumer services**

#### **A. The need to regulate service quality**

As a monopolist may overprice its goods and services and reduce their quantity and quality in order to generate additional profit, the regulation should be aimed at preventing abuse of the monopoly position with respect to all three factors. However, in many countries, economic regulation of power distribution companies remains almost exclusively price regulation, and issues of services quality do not get enough attention. On the other hand, technical standards and rules related to quality of services do not sufficiently take into account principles of cost effectiveness and efficiency. Setting a link between economic and technical regulation is a very important but also very complicated task, which the regulators face.

Price regulation without quality regulation may create distorted incentives for power distribution companies when defining the optimal level of the service quality. Different regulation formulae motivate different attitudes of regulated companies to the service quality issues. Under incentive regulation using the (RPI – X) companies try to maximize profit at the expense of reducing investments, cutting costs of equipment, maintenance, and personnel. That can lead to deterioration of the service quality. Under rate of return regulation (ROR) companies usually determine the necessary level of investments and service quality themselves. And, incentives for excessive investments are created (Averch-Johnson Effect), but there are no incentives to reduce costs and to improve the efficiency of these investments. In practice, very seldom can one observe excessively high service quality. rRather there is an imbalance between various aspects of the service quality, which does not reflect interests of consumers but reflects interests of system operators and their owners.

Any method of price regulation should be supplemented by service quality regulation, in order to exclude excessive (or non-balanced) investments in service quality improvements under cost regulation methods; and to prevent deterioration of the quality of services under incentive regulation.

#### **B. Main areas of service quality regulation**

Regulation should be aimed at those energy supply service quality indicators, which:

- are important for consumers;
- can be controlled by regulated companies;
- can be quantitatively estimated by regulators.

Importance for consumers can be assessed with the help of a consumer satisfaction survey regarding the quality of services and analysis of quality requirements from different consumer groups. As service quality for final consumers is defined by the behavior of

several companies, the regulator should clearly divide responsibilities among all the parties and apply appropriate regulatory tools to each of them.

Competition in the area of service quality requires transparency and comparability of the information on service quality of all companies. The regulator can help consumers to make a knowledgeable choice between suppliers by increasing the volume of available information on organizations, on which the service quality level depends.

The quality can be regulated both on the national and local levels. As a rule, the quality assessment is done by companies themselves, and the regulator sets rules for assessing quality indicators and verifies the procedure of carrying out the assessment.

Regulation is first of all applicable to such aspects of service quality as:

- Network safety and reliability
- Continuity of services (reliability of energy supply);
- Quality of electricity (meeting electricity physical parameter standards);
- Commercial quality (quality of relations between companies and consumers)

### **i ) Network safety and reliability**

Network safety and reliability standards and indices are developed to regulate and evaluate the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of standards. They can be determined on the results gained from data of operational security of high and medium voltage networks of distribution companies presented in the previous years. Standards usually should be different for each distribution company reflecting different parameters of the region. The main indices characterizing network security and reliability are as follows:

#### **Summarized indices**

**Outage rate, %.** The ratio of non-supplied electricity to the available electricity for consumers.

Non-supplied electricity (due to HV and MV breakdowns estimated as product of Load recorded directly before outage and duration of outage (or calculated by an accepted model).

This index is of great importance relative to production processes, as the outage may effect the revenue of big industrial companies' production processes 30 – 50 times the cost of non-supplied electricity. For residential consumers the cost may be 15-20 times the cost of non-supplied electricity in the case of a breakdown approximately 4 hours long (using an example from Hungary).

The process of collecting, calculating and presenting data should be unified for each entity, especially when comparisons of several distribution companies, regions or countries are to be made.

**Outage per consumer**, kWh/consumer, Non-supplied electricity due to HV and MV breakdowns per number of all consumers.

## **Indices according to voltage level**

### **a) High voltage**

**Number of breakdowns/100 km** (overhead and cable lines separately), *pcs/100 km*, Number of breakdowns with interruption of supply in the licensee's territory, on the HV networks, ending at the MV poles of the HV/MV transformers.

**Relative duration of breakdowns**, hrs/breakdown, ratio of summarized duration of breakdowns, hours to number of breakdowns, pcs

Duration of breakdown: time of restoration of supply from the start to the moment of full supply.

**Non-availability of HV distribution links**, ‰, ratio of yearly summarized value of breakdown durations of HV distribution elements (transformers, lines, transformer-line blocks) to the yearly summarized theoretical maximum availability of elements:

$$T_{Na} = \frac{\text{Summarized duration of non-availability of elements (hrs)} \times 1000}{\text{Number of elements} \times 8760 \text{ hrs}}$$

### **b) Medium voltage**

**Number of breakdowns/100 km**; *pcs/100 km* (all breakdowns on MV, overhead lines, underground cable lines), ratio of number of breakdowns to length of lines x 100  
Breakdowns with interruption of supply on the licensee's territory on MV network, ending at LV poles of MV/LV transformers.

**Average clearing time of breakdowns**, hrs/pcs (all breakdowns on MV, overhead lines, underground cable lines), ratio of total clearing time of breakdowns\* to number of breakdowns

Breakdowns with interruption of supply on the licensee's territory on MV network, ending at LV poles of MV/LV transformers.

### **c) Low voltage**

**Specific number of multiple breakdowns/100 km**, *pcs/100 km* (overhead lines, underground cable lines), Number of multiple breakdowns with interruption of supply on licensee's territory beginning from 0,4 kV poles of MV/LV transformers relating to 100 km network length.

Multiple breakdowns: breakdown with interruption of supply of more than 1 consumer.

**Specific number of multiple breakdowns/10000 consumers**, number of multiple breakdowns with interruption of supply on licensee's territory beginning from 0,4 kV poles of MV/LV transformers relating to 10000 consumers.

## **ii ) Continuity of services (reliability of supply)**

Continuity of services (energy supply reliability) is characterized by the number and duration of interruptions in energy supply. The data collection for creating and calculating indices and standards of continuity of supply is to be realized in careful cooperation with supply utilities. If there is no record of the number of consumers affected by an interruption, a calculation methodology has to be agreed to with the utilities in order to determine the indices of continuity of supply. In conjunction with the index, the utilities must also establish a system of recording the interruption of supply and regulators must assure that the interruptions recording method keeps the interests of consumers in mind. The procedure of determining standards is similar to that for network security: Standards should recognize different parameters (geographical, historical, etc.) of the region. Main indices of continuity of supply generally used are as follows:

**System average interruption frequency index (SAIFI)** [or Consumer interruption (CI)].

Average specific number of supply interruptions during the given year, pcs/consumer. Non-planned, long (>3 min.) interruptions on HV, MV, LV network are taken into account. For every interruption on each voltage level, the IFI (Interruption Frequency Index) is calculated:

$$IFI_i = f_i / F;$$

Where  $f_i$  = number of affected consumers,  $F$  = whole number of consumers.

$$SAIFI = \Sigma IFI_i, \text{ pcs/consumer}$$

**System Average Interruption Duration Index (SAIDI)** [or Consumer Minutes Lost

(CML)] Average duration of supply interruptions during the given year, min/consumer

Non-planned, long (>3 min.) interruptions on HV, MV, LV network are taken into account.

For every interruption on each voltage level the IDI (Interruption Duration Index) is calculated:

$$IDI_i = (f_i \times t_i) / F$$

Where  $f_i$  = number of affected consumers, pcs,  $t_i$  = duration of interruption, hrs,  $F$  = whole number of consumers, pcs.

$$SAIDI = \Sigma IDI_i \text{ hours/consumer.}$$

**Customer Average Interruption Duration Index, (CAIDI)**, hrs/consumer, average duration of (total, planned, unplanned) interruptions of supply for consumers affected

$$CAIDI = \Sigma (f_i \times t_i) / \Sigma f_i = SAIDI / SAIFI.$$

**Average Service Availability Index, (ASAI)**, the ratio of total customer hours that service was available divided by the total customer hours demanded in a time period.

$$ASAI = (8760 - SAIDI) / 8760 = 1 - SAIDI / 8760.$$

***Number and ratio of worst-served consumers***, pcs consumers affected, %

The consumer supplied from MV network is worst-served, if the duration of non-planned long (>3 min.) interruptions of supply is 2 times higher than SAIDI.

***Restoration in the case of unplanned interruption***, %, Ratio of restored *within 3 and 24 hours* consumers to the whole number of consumers affected by breakdown, separately on MV and LV lines.

***Restoration in the case of planned interruption***, %, Ratio of restored *within 6 and 12 hours* consumers to the whole number of consumers affected by breakdown, separately on MV and LV lines.

Regulation of reliability of supply is aimed at compensating consumer damage suffered due to lengthy interruptions in energy supply, at reducing the energy supply restoration time and at creating incentives to reduce the number and duration of interruptions.

### **iii) Power Quality**

In many countries, network companies have to follow voltage quality standards prescribed in the European standard EN 50 160, Interstate standard GOST 13109-97 or other (national) standards. The quality of electricity, as a rule, means compliance of physical parameters of supplied electricity to set standards. Most often the following are considered as electricity quality indicators:

- frequency deviations,
- voltage fluctuations,
- voltage fall,
- voltage impulse,
- temporary overvoltage,
- asymmetry in phase voltages, and
- voltage nonsensicality.

Main indices of supply relating to voltage quality:

***Consumer voltage complaints***, pcs/10 000 consumers, Number of justified consumer voltage complaints per 10 000 consumers.

***Consumers with permanent non-standard voltage***, pcs/10 000 consumers, Number of consumers with permanent (lasting more than 12 monthes) non-standard voltage per 10 000 consumers.

#### iv) Commercial quality

Commercial quality characterizes the quality of relations between the supplier and consumer. These relations are multidimensional, but only certain types can be assessed in quantitative terms and controlled by the regulator by means of setting overall service standards (Overall Standards) or standards of providing services to individual consumers, which are often referred to as Guaranteed Standards. Guaranteed standards, as a rule, in case not observed, suggest that the supplier would indemnify consumers. Standards can include maximal time for: connecting consumers, installing meters, providing information to consumers, responding to telephone calls, making consumer visits, answering complaints, provisioning services in case of emergency situations, etc. Examples of Guaranteed Standards are found on table 8 and examples of Overall Standards are found on table 9.

<b>Table 8. Guaranteed service quality standards</b>		
<b>Service</b>	<b>Quality level</b>	<b>Fine (compensation for consumer in case of failure)</b>
Taking measures after company's safety device is off	Measures should be taken within 3 hours during week days and 4 hours on week-ends	20 £
Restoration of supply after the breakdown	Within 18 hours	50 £ for residential consumers, 100 £ for non-residential, and 25 £ for every subsequent 12 hours
Multiple interruptions in energy supply	4 or more separate interruptions for 3 or more hours a year	50 £
Estimate of the connection fee	5 business days for simple work and 15 business days for more complicated work	40 £
Notification of scheduled interruption in energy supply	Two days prior to the interruption	20 £ for residential consumers, 40 £ for non-residential consumers
Considering electricity quality complaints	Visit within 7 business days or a justified answer in 5 days	20 £
Time when the work should be scheduled and carried out	The company should carry out work in the morning or in the evening, or at some fixed time, if the consumer requests so	20 £
Notification of consumers on compensation for non-compliance with standards	Payment should be done within 10 business days	20 £

<b>Table 9. Overall service quality standards</b>	
<b><i>Services</i></b>	<b><i>Requirements</i></b>
Restoration of energy supply: minimal percentage of consumers for which the energy supply should be restored within 18 hours	99,5%
Electricity quality complaints: minimal percentage of satisfied complaints within 6 months	100%
New connections: minimal percentage of new residential consumers who have to be connected within 30 days	100%
New connections: minimal percentage of new non-residential consumers, which have to be connected within 30 days	100%
Correspondence: minimal percentage of letters from consumers, which were answered within 10 days	100%
Multiple interruptions in energy supply (from 1 April, 2002): minimal percentage of consumers who had not more than five interruptions that lasted 3 or more minutes	96-99%

### **C. Service quality regulation principles**

In the course of the service quality regulation the regulator should concentrate its efforts on achievement of the final goal (improvement of the quality of services for consumers), and not on detailed regulation of ways to achieve these tasks. The regulator should not interfere in selection of technical solutions or investment programs; if the results can be quantitatively measured the regulator should focus on them. If the quality indicators are regulated, the suppliers can benefit when costs associated with quality management are efficient.

Quality standards should reflect consumer preferences and their readiness to pay for better quality.

Quality regulation as a rule is based on the balance between costs and outputs, which the regulator can evaluate based on the available information, and it should be taken into account that costs differ for different companies and different geographic areas, and consumer benefits can be differentiate individually. The process of quality regulation should be under permanent monitoring. Standards, as well as penalties and incentives should be periodically reviewed and changed, if necessary.

With industry converting from monopoly to competition, quality regulation should more and more be replaced with the competition on service quality indicators; however, full deregulation of the service quality of natural monopolies is impossible.

## **D. Service quality regulation mechanisms**

To achieve optimal service quality, the price for services of regulated companies has to change to reflect the service quality. Theoretically this can be achieved by including in the price regulation formula an appropriate element (under incentive regulation). However, this method is not applicable to all factors determining the quality of services, and in addition, such a method does not guarantee a minimal level of service quality for consumers. That is why regulators use a wide range of other mechanisms. The most common are:

- Publishing comparative information on service quality of various companies in order to promote yardstick competition between them on quality indices. This method requires clear and detailed rules of quantitative evaluation of service quality indices.
- Application of general and guaranteed quality standards.
- Application of economic sanctions (fines) in case of non-compliance with standards. Fines should be large enough to motivate companies to comply with standards. They have to be paid to affected consumers or have to be used to finance programs of service quality improvement.
- Written notifications, making amendments in license conditions, or revocation of licenses.
- Decrease of tariff or other economic sanctions affecting a company's revenue and profit. Inclusion of Q-factor covering various quality factors, consumer satisfaction indices, personnel health and safety indices, etc. in the price cap formula.
- Incentives for gradual improvement of the level of quality.

## **E. System of service quality regulation in the Hungarian power sector**

Many countries of Western and Central Europe created systems to regulate service quality of energy companies. Hungary can be used as an example, where according to laws on electricity of 1994 and 2001, the energy regulatory body has the right to control the quality of services provided by license holders. The quality control process goes as following:

- Collection and analysis of statistical reports of licensees on interruptions in energy supply
- Sociological research of the levels of consumer satisfaction with the quality of provided services
- Introduction of guaranteed and general standards of service quality and compliance control.

### i) Reporting of license holders on service quality issues

The most important element in the system of quality regulation is monitoring of the level of service quality, which is carried out by the regulator by analyzing licensees' reports on energy supply interruptions. The licensee has to submit to the regulator an annual statistic report on interruptions in the energy supply. For each type of license, a certain reporting form is envisioned, and it should meet the following requirements:

- The data of the report should be presented in the form convenient for benchmarking among enterprises and data for previous years.
- The report should contain main data for the past five years in order to analyze the dynamics of changes in service quality indicators.
- The reports should contain elements applicable to international benchmarking of service quality.
- The information should be presented in the form that is suitable for computer processing.

Authenticity of the reporting data is evaluated by the regulator and is subject to audits. Table 10 shows summarized data from the reports on energy supply reliability in Hungary for the period 1996 -2002.

*Table 10. Energy supply reliability indicators in Hungary (1996-2002)*

	1996	1997	1998	1999	2000	2001	2002
Average losses due to interruptions in energy supply per consumer (kWh/consumer)	0.895	0.726	0.838	1.294	0,876	0,856	0,762
Number of interruptions at high voltage lines	53	36	24	33	48	24	19
Number of interruptions at medium voltage lines	10 493	8 570	10 207	10 816	8015	7811	7209
Electricity losses due to interruptions at medium voltage lines, (MWh)	4 510	3 452	4 096	6 433	4253	4257	3850
Duration of interruptions in energy supply at medium voltage lines (hours)	15 928	11 900	16 240	26 362	15374	15606	12999
Number of interruptions at low voltage lines	241 760	225 421	214 325	183 730	189654	176632	175000
Adjusted number of individual interruptions per thousand consumers (number of interruptions/1000 consumers)	35.65	32.05	29.31	24.32	25	23	22

Adjusted number of multiple interruptions per thousand consumers (number of interruptions/1000 consumers)	13.32	13.06	13.26	12.00	12,67	11,67	11,73
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Timely introduction of the service quality monitoring played a very positive role in 1997 after converting to the incentive regulation by price-cap formula, which, as it is well known, promotes reduction of costs of the enterprise-supplier, but does not promote the improvement of the service quality. Having analyzed the information on interruptions in the energy supply, the regulator found out that in 1999 four out of six energy distribution companies had significant decreases in the quality of their services. And that is why they were penalized in 2000. As a result of using penalties and other methods of regulation, starting with 2000, there is permanent improvement of the security of energy supply indicators.

In addition to annual reports, licensees have to submit to the regulator separate reports on all events of national significance, that lead to interruptions in the energy supply of a significant number of consumers or the most important facilities. An on site investigation is carried out for each such event, and in the course of such investigation, social implications of the event are assessed, consumer complaints are examined, measures for restoration of energy supply are scheduled, and the report is drawn up.

## **ii) Evaluation of the opinion of consumers on the quality of provided services**

The level of consumer satisfaction with the quality of provided services is evaluated with the help of sociological research (polls) conducted by independent sociological organizations simultaneously for all companies according to strictly set procedures approved and published by the regulator.

It is very important to ensure representative sampling of residential and commercial consumers for statistical analysis; this sampling should correspond to statistical confidence of at least 95%, with permissible error not exceeding 5%. Sampling of residential consumers is done in two stages – at the first one the representative of the region is ensured, and at the second one - representative of a certain individual locality. Sampling of commercial consumers is also done in two stages: at the first one the representative by levels of consumption is ensured (four categories), and at the second one – industrial proportions. Individual respondents are selected by random choice (randomization).

Questions related to the following components of the service quality are included in questionnaires:

- quality of energy supply (quality of goods or services, time needed to eliminate violations)
- operational contacts of the company with consumers (meter reading, billing, procedure of payment, addressing consumer complaints)
- work with consumers (evaluation of the employees' work with clients, provision of information to consumers, external relations)

- prices (tariffs, discounts, tariff zones).

The scale from 1 to 5 is used to evaluate the service quality. The degree of authenticity of results should be at least 95%, with permissible error not exceeding 5%. The general score is determined on the basis of scores by individual components of the service quality taking into account the hierarchy of components in the priorities of consumers. The result of the analysis is the index of consumer satisfaction, as a summarizing measure of the service quality evaluation. Summarized indices of consumer satisfaction with the service quality in Hungary for 1996-1999 (calculated using the old methodology) and for 2003-2004 (calculated using the new methodology) are shown in table 11.

*Table 11. Summarized indices of consumer satisfaction with the quality of services (1996-1999 and 2003-2004).*

Company (regional distribution / supply company)	Summarized indices of consumer satisfaction							
	According to the old methodology				According to the new methodology			
	1996	1997	1998	1999		2003	2004	
<b>DÉDÁSZ</b>	69,5	67,4	65,4	<b>69,0</b>		75,2	73,5	
<b>DÉMÁSZ</b>	67,9	69,8	71,1	<b>69,0</b>		80,8	80,5	
<b>ELMŰ</b>	60,5	64,8	67,6	<b>65,4</b>		78,5	77,3	
<b>ÉDÁSZ</b>	64,8	68,1	74,1	<b>74,8</b>		77,9	74,3	
<b>ÉMÁSZ</b>	66,3	69,3	70,7	<b>68,6</b>		78,1	80,1	
<b>TITÁSZ</b>	65,1	65,5	66,3	<b>67,6</b>		77,3	69,0	
<b>Average for Hungary</b>	<b>65,7</b>	<b>67,5</b>	<b>69,2</b>	<b>69,1</b>		<b>78,0</b>	<b>75,8</b>	

### iii) Guaranteed and general service quality standards

The regulator succeeded in finding a compromise with companies in terms of setting general (minimal) and guaranteed service quality standards (table 12). In 1999, the decision was made according to which energy companies have to pay 1000 Hungarian Forint (HUF) (3.5 U.S. dollars) to each consumer who suffered due to non-observance of guaranteed quality standards. Since 2003, the size of compensations significantly increased. In the case of automatic payment of compensation (without any application from the consumer) it amounts to 2000 forints for residential consumers, 6000 forints for other low voltage consumers, and 15000 forints for consumers connected to medium voltage networks. In case of payment upon the request of the consumer, the amount is already 5000 forints for residential consumers, 10000 forints for other low voltage consumers, and 30000 forints for consumers connected to medium voltage networks.

Annually, the regulator receives a report on meeting guaranteed quality standards. In addition to guaranteed standards (all in all there are 13 standards) general standards were introduced in Hungary, which set minimal acceptable level of service quality.

*Table 12. Certain guaranteed service quality standards in Hungary*

Time period until the work on restoration of energy supply to the individual consumer begins	Locality with population >50000: max. 4 hours Locality with population 5000-50000: max. 6 hours Locality with population <5000: max. 8 hours Outside of localities: max. 12 hours
Energy supply restoration time in case of disconnection	In case of an individual consumer: not more than 12 hours In case of multiple consumers: not more than 16 hours
Connection of a new consumer	8 days after an official request was received
Observance of the arrangement on the time of supplier's visit to the consumer to connect the consumer and to verify the meter	Deviations not more than 4 hours from the time coordinated with the consumer
Response to a consumer's written complaint	Response within 15 days

#### **IV. Questionnaire and it's results**

During the preparatory stage of performance analyses, the outer framework of benchmarking, as a general concept, was drawn in six stages. The first aim was to understand "what does performance evaluation mean to the members of ERRA?" via feedback from a questionnaire.

First step in the questionnaire was the implementation of performance evaluation. It is possible to implement a performance analysis under three main titles: utilities-consumer perspectives related to efficiency, productivity and customer satisfaction; technical engineering perspectives related to system sustainability, security and standards; and last but not least, financial performance of the utilities (analysis of liquidity and solvency) related to continuity of the business.

The second and third steps took "timing" into consideration and tried to find out when and at what frequency those performance evaluations procedures have been implemented. The next question, relating to the most important aspect of performance evaluation, tried to concentrate on methodology. This included benchmarking techniques (frontiers techniques –Data Envelopment Analyses or Stochastic Frontier Analyses- or average techniques) for

future steps of this collaborated working project, including international benchmarking, regional benchmarking, yardstick competition, technical standards etcetera.

The fifth question emphasized the functional diversification of performance standards. Since unbundling of the vertically integrated structure of electricity markets has been realized or is being realized all over the ERRA region, it is very crucial to decide which performance evaluation methodologies should be used for which function in order to provide successful electricity market reform.

The last part of the questionnaire revealed our intention of sharing all the valuable ideas and support of the member states. A joint initiative, contributes to the enrichment of ERRA common interests, can be triggered among ERRA members to set up a common benchmarking model. This common model can lead to the benchmarking of all members' distribution and transmission activities, and the establishment of a data base which can be used as a source of information by member countries individually in their benchmarking studies.

**Q1: What kind of performance evaluations are performed in your country**

	✓	✗	✓	✗
ARMENIA				
ARMENIA	✓	✓		
BULGARIA				
CROATIA		✓	✓	
CZECH REP.				
ESTONIA				
GEORGIA				
HUNGARY	✓	✓	✓	
KAZAKHSTAN				
KIRGIZ REP.				
LATVIA				
LITHUANIA	✓		✓	
MACEDONIA				
POLAND				
ROMANIA	✓	✓		
RUSSIA				
SRBIAN		✓	✓	
TURKEY	✓		✓	
UKRAINE		✓	✓	

**CHOICES:**

**A: Utilities-consumer perspective**  
(efficiency assessment, productivity improvement, quality assessment, customer services quality etc...)

**B: Technical-engineering perspective**  
(network safety and performance, system sustainability, environmental concerns...)

**C: Financial performance evaluation of the utilities**  
(financial sustainability, sufficiency...)

**D: Others, please indicate**

October 25-26, 2004  
Page 3

Q2: At which stage performance evaluation criteria are included into the regulation process?

	✓	✗	✓	✗
ALGERIA				
ARMENIA		✓	✓	
AZERBAIDJAN				
BELARUS	✓	✓		
BULGARIA				
CROATIA				
CYPRUS				
CZE REPUBLIC	✓		✓	
ESTONIA				
GEORGIA				
HUNGARY	✓		✓	
ISRAEL				
ITALY		✓	✓	
KAZAKHSTAN	✓	✓	✓	
KYRGYZ REP.				
LATVIA		✓	✓	
LITHUANIA				
NETHERLANDS				
ROMANIA				
RUSSIA		✓		
UKRAINE			✓	
USA	✓		✓	
UZBEKISTAN	✓			

## CHOICES:

A: Before licensing procedure as pre-requested

B: During licensing procedure as compulsory or voluntary technical standards

C: Included into the tariffs as performance target

D: Others, please indicate

October 25-26, 2004  
Page 7

Q3: At which frequency performance evaluation methodologies or standards are reviewed?

	REVIEW FREQUENCY
ALGERIA	
ARMENIA	
AZERBAIDJAN	
BELARUS	
BULGARIA	
CROATIA	
CYPRUS	
CZE REPUBLIC	Yearly and occasionally
ESTONIA	
GEORGIA	
HUNGARY	Once a year
ISRAEL	Annually and every three years
ITALY	
KAZAKHSTAN	Performance standard for distribution and performance standard for supply standards for 3 to 5 years.
KYRGYZ REP.	
LATVIA	On beginning of regulation period
LITHUANIA	At the beginning of the implementation period
NETHERLANDS	Performance evaluation can be performed on annual basis
ROMANIA	
RUSSIA	
UKRAINE	
USA	
UZBEKISTAN	

Q4: What kind of pricing performance evaluation methodologies are being used in your country?

	✓	✗	✓	✗	✓
AFRICA					
ASIA			✓	✓	
AUS/OSIA					
CANADA	✓				
CENTRAL/SE. EUROPE					
EUROPE					
GLOBAL					
INDONESIA		✓		✓	
INTERMEDIATE					
NORTH/SE. ASIA					
SAF/SEA			✓		
SE/AFRICA	✓	✓			
INDONESIA					
EUROPE					
ASIA				✓	
AFRICA					
OS/AFRICA	✓	✓			
EUROPE	✓	✓		✓	
GLOBAL		✓	✓		

## CHOICES:

- A: International benchmarking
- B: Regional benchmarking within the country
- C: Yardstick competition
- D: Technical standards
- E: Others, please indicate

Q5: In your opinion, performance evaluation should be used in;

	✓	✗	✓	✗	✓
AFRICA					
ASIA	✓	✓	✓	✓	
AUS/OSIA					
CANADA	✓	✓	✓	✓	
CENTRAL/SE. EUROPE					
EUROPE					
GLOBAL					
INDONESIA	✓	✓	✓	✓	
INTERMEDIATE					
NORTH/SE. ASIA					
SAF/SEA		✓	✓		
SE/AFRICA		✓	✓		
INDONESIA					
EUROPE					
ASIA					
AFRICA					
OS/AFRICA		✓	✓	✓	
EUROPE		✓	✓		
GLOBAL	✓	✓	✓		

## CHOICES:

- A: Generation
- B: Transmission
- C: Distribution
- D: Retail sale and retail sale services
- E: Others, please indicate

October 25-26, 2004  
Page 12

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This publication was made possible through support provided by the Energy and Infrastructure Division of the Bureau of Europe and Eurasia under the terms of its Cooperative Agreement with the National Association of Regulatory Utility Commissioners, No. EE-N-00-99-00001-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development or National Association of Regulatory Utility Commissioners.

# ERRA Legal Regulation Working Group:

## Glossary of Legal Terms

### **Definitions were used based on:**

***Regulation (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity***

***Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC***

***Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC***

***Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market***

## A

**affiliate** – a company that is controlled by another or that has the same owner as another company (*ERRA Legal Regulation Working Group Terms*).

**aggregation** - the process of organizing small groups, businesses or residential customer into a larger, more effective bargaining unit that strengthens their purchasing power with utilities  
(*ERRA Legal Regulation Working Group Terms*)

**agreement** - verbal or written agreement between the seller and buyer of the electricity or natural gas, which is the bases for selling and buying processes.  
(*ERRA Legal Regulation Working Group Terms*)

**ancillary services** - services necessary for the transmission of energy from resources to loads.  
(*ERRA Legal Regulation Working Group Terms*)

**ancillary services** means all services necessary for the operation of a transmission or distribution system; (*Directive 2003/54/EC*)

**ancillary services** means all services necessary for access to and the operation of transmission and/or distribution networks and/or LNG facilities and/or storage facilities including load balancing and blending, but excluding facilities reserved exclusively for transmission system operators carrying out their functions (*Directive 2003/55/EC*);

**average cost** - The revenue requirement of a utility divided by the utility's sales. Average cost typically includes the costs of existing power plants, transmission, and distribution lines, and other facilities used by a utility to serve its customers. It also includes operations and maintenance, tax, and fuel expenses (*ERRA Legal Regulation Working Group Terms*).

**avoided costs** - these are costs that a utility avoids by purchasing power from an independent producer rather than generating power themselves, purchasing power from another source or constructing new power plants. A Public Utility Commission calculates avoided costs for each utility, and these costs are the basis upon which independent power producers are paid for the electricity they produce. There are two parts to an avoided cost calculation: the avoided capacity cost of constructing new power plants and the avoided energy cost of fuel and operating and maintaining utility power plants (*ERRA Legal Regulation Working Group Terms*).

## **B**

**bilateral contract** - a direct contract between the power producer and user or broker outside of a centralized power pool (*ERRA Legal Regulation Working Group Terms*).

**bilateral contract** proposal for new definition – a contract between two independent market players including also the centralized power pool (*ERRA Legal Regulation Working Group Terms*).

**biomass** - plant materials and animal waste used as a source of fuel (*ERRA Legal Regulation Working Group Terms*).

**biomass** shall mean the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste (*Directive 2001/77/EC*);

**blackout** - a power loss affecting many electricity consumers over a large geographical area for a significant period of time (*ERRA Legal Regulation Working Group Terms*).

**broker** - a retail agent who buys and sells power. The agent may also aggregate customers and arrange for transmission, firming and other ancillary services as needed (*ERRA Legal Regulation Working Group Terms*).

## **C**

**capacity** - the maximum load a generating unit, generating station, or other electrical apparatus is rated to carry by the user or the manufacturer or can actually carry under existing service conditions (*ERRA Legal Regulation Working Group Terms*).

**captive customer** - a customer who does not have realistic alternatives to buying power from the local utility, even if that customer had the legal right to buy from competitors (*ERRA Legal Regulation Working Group Terms*).

**captive consumer** proposal for new definition- a customer who does not have alternatives to choose supplier.” (*ERRA Legal Regulation Working Group Terms*);

**cogeneration** - production of heat energy and electrical or mechanical power from the same fuel in the same facility. A typical cogeneration facility produces electricity and steam for industrial process use (*ERRA Legal Regulation Working Group Terms*).

**cogenerator** - A facility that produces electricity and/or other energy for heating and cooling. (*ERRA Legal Regulation Working Group Terms*).

**community law** - consists of the founding Treaties (primary legislation) and the provisions of instruments enacted by the Community institutions by virtue of them (secondary

legislation). In a broader sense, Community law encompasses all the rules of the Community legal order, including general principles of law, the case law of the Court of Justice, law flowing from the Community's external relations and supplementary law contained in conventions and similar agreements concluded between the Member States to give effect to Treaty provisions. All these rules of law form part of what is known as the *Community acquis*. (ERRA Legal Regulation Working Group Terms).

**competition** - the competition between the licensees, by the economic activities that prevents the privileges and support more effective service (ERRA Legal Regulation Working Group Terms);

**congestion** means a situation in which an interconnection linking national transmission networks, cannot accommodate all physical flows resulting from international trade requested by market participants, because of a lack of capacity of the interconnectors and/or the national transmission systems concerned (Regulation (EC) No. 1228/2003);

**connection** - the connection between two electrical systems that permit the transfer of energy (ERRA Legal Regulation Working Group Terms);

**conservation** - a foregoing or reduction of electric usage for the purpose of saving natural energy resources and limiting peak demand in order to ultimately reduce the capacity requirements for plant and equipment (ERRA Legal Regulation Working Group Terms);

**consumer education** - efforts to provide consumers with skills and knowledge to use their resources wisely in the marketplace (ERRA Legal Regulation Working Group Terms);

**consumption** (Fuel) - amount of fuel used for gross generation (ERRA Legal Regulation Working Group Terms);

**consumption of electricity** shall mean national electricity production, including autoproduction, plus imports, minus exports (gross national electricity consumption) (Directive 2001/77/EC);

**contract price** - price marketed on a contract basis for one or more years (ERRA Legal Regulation Working Group Terms);

**customers** means wholesale and final customers of electricity (Directive 2003/54/EC);

**customers'** means wholesale and final customers of natural gas and natural gas undertakings which purchase natural gas (Directive 2003/55/EC);

**customer class** - a distinction between users of electric energy. Customer class is usually defined by usage patterns, usage levels, and conditions of service. Classes are usually categorized generically by customer activity (e.g. residential, commercial, industrial, agricultural, street lighting). (ERRA Legal Regulation Working Group Terms);

**customer service protection** - the rules governing grounds for denial of service, credit determination, deposit and guarantee practices, meter reading and accuracy, bill contents, billing frequency, billing accuracy, collection practices, notices, grounds for termination of service, termination procedures, rights to reconnection, late charges, disconnection/reconnection fees, access to budget billing and payment arrangements, extreme weather, illness or other vulnerable customer disconnection protections, and the like. In a retail competition model, would include protections against "slamming" and other hard-sell abuses. (*ERRA Legal Regulation Working Group Terms*);

**cross-border flow** means a physical flow of electricity on a transmission network of a Member state that results from the impact of the activity of producers and/or consumers outside of that Member State on its transmission network. If transmission networks of two or more Member States form part, entirely or partly, of a single control block, for the purpose of the inter-transmission system operator (TSO) compensation mechanism referred to in Article 3 only, the control block as a whole shall be considered as forming part of the transmission network of one of the Member States concerned, in order to avoid flows within control blocks being considered as cross-border flows and giving rise to compensation payments under Article 3. The regulatory authorities of the Member States concerned may decide which of the Member States concerned shall be the one of which the control block as a whole shall be considered to form part of (*Regulation (EC) No. 1228/2003*);

**cross-subsidization** - this refers to the transfer of assets or services from the regulated portion of an electric utility to its unregulated affiliates to produce an unfair competitive advantage. Also, cross-subsidization can refer to one rate class (such as industrial customers) subsidizing the rates of another class (such as residential customers). (*ERRA Legal Regulation Working Group Terms*);

## **D**

**daily peak** - the maximum amount of energy or service demanded in one day from a company or utility service (*ERRA Legal Regulation Working Group Terms*);

**declared export** of electricity means the dispatch of electricity in one Member State on the basis of an underlying contractual arrangement to the effect that the simultaneous corresponding take-up ('declared import') of electricity will take place in another Member State or a third country (*Regulation (EC) No. 1228/2003*);

**declared import** of electricity means the take-up of electricity in a Member State or a third country simultaneously with the dispatch of electricity ('declared export') in another Member State (*Regulation (EC) No. 1228/2003*);

**declared transit** of electricity means a circumstance where a 'declared export' of electricity occurs and where the nominated path for the transaction involves a country in

which neither the dispatch nor the simultaneous corresponding take-up of the electricity will take place (*Regulation (EC) No. 1228/2003*);

**demand (electric)** - the rate at which electric energy is delivered to or by a system, part of a system, or a piece of equipment. Demand is expressed in kW, kVA, or other suitable units at a given instant or over any designated period of time. The primary source of "demand" is the power-consuming equipment of the customers (*ERRA Legal Regulation Working Group Terms*);

**deregulation** - the elimination of regulation from a previously regulated industry or sector of an industry (*ERRA Legal Regulation Working Group Terms*);

**direct access** - The ability of a retail customer to purchase commodity electricity directly from the wholesale market rather than through a local distribution utility (*ERRA Legal Regulation Working Group Terms*);

**direct line** means either an electricity line linking an isolated production site with an isolated customer or an electricity line linking an electricity producer and an electricity supply undertaking to supply directly their own premises, subsidiaries and eligible customers (*Directive 2003/54/EC*);

**direct line** means a natural gas pipeline complementary to the interconnected system (*Directive 2003/55/EC*);

**distributed generation** means generation plants connected to the distribution system (*Directive 2003/54/EC*).

**distribution** means the transport of electricity on high-voltage, medium voltage and low voltage distribution systems with a view to its delivery to customers, but not including supply (*Directive 2003/54/EC*)

**distribution** means the transport of natural gas through local or regional pipeline networks with a view to its delivery to customers, but not including supply (*Directive 2003/55/EC*);

**distribution** - the system of wires, switches, and transformers that serve neighbourhoods and business, typically lower than 69,000 volts. A distribution system reduces or downgrades power from high-voltage transmission lines to a level that can be used in homes or businesses (*ERRA Legal Regulation Working Group Terms*);

**distribution line** - this is a line or system for distributing power from a transmission system to a customer. It is any line operating at less than 69,000 volts (*ERRA Legal Regulation Working Group Terms*);

**distribution system** - that part of the electric system that delivers electric energy to consumers (*ERRA Legal Regulation Working Group Terms*);

**distribution system operator** means a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long term ability of the system to meet reasonable demands for the distribution of electricity;(*Directive 2003/54/EC*)

**distribution system operator** means a natural or legal person who carries out the function of distribution and is responsible for operating, ensuring the maintenance of, and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of gas (*Directive 2003/55/EC*);

**distribution utility (Disco)** - The regulated electric utility entity that constructs and maintains the distribution wires connecting the transmission grid to the final customer. The Disco can also perform other services such as aggregating customers, purchasing power supply and transmission services for customers, billing customers and reimbursing suppliers, and offering other regulated or non-regulated energy services to retail customers. The "wires" and "customer service" functions provided by a distribution utility could be split so that two totally separate entities are used to supply these two types of distribution services (*ERRA Legal Regulation Working Group Terms*);

## **E**

**economic efficiency** - A term that refers to the optimal production and consumption of goods and services. This generally occurs when prices of products and services reflect their marginal costs. Economic efficiency gains can be achieved through cost reduction, but it is better to think of the concept as actions that promote an increase in overall net value (which includes, but is not limited to, cost reductions) (*ERRA Legal Regulation Working Group Terms*);

**economic precedence** means the ranking of sources of electricity supply in accordance with economic criteria (*Directive 2003/54/EC*);

**electric distribution company** - the company that owns the power lines and equipment necessary to deliver purchased electricity to the customer (*ERRA Legal Regulation Working Group Terms*);

**electric plant (Physical)** - a facility that contains all necessary equipment for converting energy into electricity (*ERRA Legal Regulation Working Group Terms*);

**electric power supplier** - non-utility provider of electricity to a competitive marketplace (*ERRA Legal Regulation Working Group Terms*);

**electric system** - this term refers to all of the elements needed to distribute electrical power. It includes overhead and underground lines, poles, transformers, and other equipment (*ERRA Legal Regulation Working Group Terms*);

**electric utility** - a legal entity that owns and/or operates facilities for the generation, transmission, distribution, or sale of electric energy (*ERRA Legal Regulation Working Group Terms*);

**electric utility affiliate** - this refers to a subsidiary or affiliate of an electric utility. Many utilities form affiliates to develop, own, and operate independent power facilities (*ERRA Legal Regulation Working Group Terms*);

**electricity produced from renewable energy sources** shall mean electricity produced by plants using only renewable energy sources, as well as the proportion of electricity produced from renewable energy sources in hybrid plants also using conventional energy sources and including renewable electricity used for filling storage systems, and excluding electricity produced as a result of storage systems (*Directive 2001/77/EC*);

**eligible customers** means customers who are free to purchase electricity from the supplier of their choice within the meaning of Article 21 of this Directive (*DIRECTIVE 2003/54/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC*);

**eligible customers** means customers who are free to purchase gas from the supplier of their choice, within the meaning of Article 23 of this Directive (*DIRECTIVE 2003/55/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC*);

**emergent market** means a Member State in which the first commercial supply of its first long-term natural gas supply contract was made not more than 10 years earlier (*Directive 2003/55/EC*);

**end-use** - the specific purpose for which electric is consumed (I.e. heating, cooling, cooking, etc.) (*ERRA Legal Regulation Working Group Terms*);

**energy charge** - the amount of money owed by an electric customer for kilowatt-hours consumed (*ERRA Legal Regulation Working Group Terms*);

**energy consumption** - the amount of energy consumed in the form in which it is acquired by the user. The term excludes electrical generation and distribution losses (*ERRA Legal Regulation Working Group Terms*);

**energy costs** - costs, such as for fuel, that are related to and vary with energy production or consumption (*ERRA Legal Regulation Working Group Terms*);

**energy efficiency** - programs that reduce consumption (*ERRA Legal Regulation Working Group Terms*);

**energy resources** - everything that could be used by society as a source of energy (*ERRA Legal Regulation Working Group Terms*);

**energy source** - a source that provides the power to be converted to electricity (*ERRA Legal Regulation Working Group Terms*);

**energy use** - energy consumed during a specified time period for a specific purpose (usually expressed in kWh) (*ERRA Legal Regulation Working Group Terms*);

## **F**

**facility** - a location where electric energy is generated from energy sources (*ERRA Legal Regulation Working Group Terms*);

**final customers** means customers purchasing electricity for their own use (*Directive 2003/54/EC*);

**final customers** means customers purchasing natural gas for their own use (*Directive 2003/55/EC*);

**functional unbundling** - the functional separation of generation, transmission, and distribution transactions within a vertically integrated utility without selling of "spinning off" these functions into separate companies (*ERRA Legal Regulation Working Group Terms*);

## **G**

**generation** means the production of electricity (*Directive 2003/54/EC*)

**generating unit** - combination of connected prime movers that produce electric power (*ERRA Legal Regulation Working Group Terms*);

**generation (electricity)** - process of producing electric energy by transforming other forms of energy (*ERRA Legal Regulation Working Group Terms*);

**generation company (Genco)** - a regulated or non-regulated entity (depending upon the industry structure) that operates and maintains existing generating plants. The Genco may own the generation plants or interact with the short term market on behalf of plant owners. In the context of restructuring the market for electricity, Genco is sometimes used to describe a specialized "marketer" for the generating plants formerly owned by a vertically-integrated utility (*ERRA Legal Regulation Working Group Terms*);

**geothermal** - an electric generating station in which steam tapped from the earth drives a turbine-generator, generating electricity (*ERRA Legal Regulation Working Group Terms*);

**grid** - matrix of an electrical distribution system (*ERRA Legal Regulation Working Group Terms*);

**group consumption** - (service) buying electricity or gas for the self consumption of one or more persons (*ERRA Legal Regulation Working Group Terms*);

## **H**

**horizontally integrated undertaking** means an undertaking performing at least one of the functions of generation for sale, or transmission, or distribution, or supply of electricity, and another non electricity activity (*Directive 2003/54/EC*);

**horizontally integrated undertaking** means an undertaking performing at least one of the functions of production, transmission, distribution, supply or storage of natural gas, and a non-gas activity (*Directive 2003/55/EC*);

**household customers** means customers purchasing electricity for their own household consumption, excluding commercial or professional activities (*Directive 2003/54/EC*);

**household customers** means customers purchasing natural gas for their own household consumption (*Directive 2003/55/EC*);

## **I**

**independent power producers (IPPs)** - these are private entrepreneurs who develop, own or operate electric power plants fueled by alternative energy sources such as biomass, cogeneration, small hydro, waste-energy and wind facilities (*ERRA Legal Regulation Working Group Terms*);

**independent system operator (ISO)** - an ISO is the entity charged with reliable operation of the grid and provision of open transmission access to all market participants on a non-discriminatory basis (*ERRA Legal Regulation Working Group Terms*);

**interconnection (electric utility)** - the linkage of transmission lines between two utility, enabling power to be moved in either direction. Interconnections allow the utilities to help contain costs while enhancing system reliability (*ERRA Legal Regulation Working Group Terms*);

**interconnectors** means equipment used to link electricity systems (*Directive 2003/54/EC*);

**interconnected system** means a number of transmission and distribution systems linked together by means of one or more interconnectors (*Directive 2003/54/EC*);

**interconnected system** means a number of systems which are linked with each other (*Directive 2003/55/EC*);

**interconnector** means a transmission line which crosses or spans a border between Member States for the sole purpose of connecting the national transmission systems of these Member States (*Directive 2003/55/EC*);

**integrated electricity undertaking** means a vertically or horizontally integrated undertaking (*Directive 2003/54/EC*);

**integrated natural gas undertaking** means a vertically or horizontally integrated undertaking  
(*Directive 2003/55/EC*);

## **J**

**jurisdiction**– the power of a court or judge to entertain an action, petition or other proceeding. Jurisdiction also signifies the district or geographical limits within which the judgements or orders of a court can be enforced or executed (*ERRA Legal Regulation Working Group Terms*);

## **L**

**line** - a line is a system of poles, conduits, wires, cables, transformers, fixtures, and accessory equipment used for the distribution of electricity to the public (*ERRA Legal Regulation Working Group Terms*);

**linepack** means the storage of gas by compression in gas transmission and distribution systems, but excluding facilities reserved for transmission system operators carrying out their functions  
(*Directive 2003/55/EC*);

**LNG facility** means a terminal which is used for the liquefaction of natural gas or the importation, offloading, and re-gaseification of LNG, and shall include ancillary services and temporary storage necessary for the re-gaseification process and subsequent delivery to the transmission system, but shall not include any part of LNG terminals used for storage  
(*Directive 2003/55/EC*);

**LNG system operator** means a natural or legal person who carries out the function of liquefaction of natural gas, or the importation, offloading, and re-gaseification of LNG and is responsible for operating a LNG facility (*Directive 2003/55/EC*);

**load** - the amount of electric power delivered or required at any specified point or points on a system. Load originates primarily at the power consuming equipment of the customer  
(*ERRA Legal Regulation Working Group Terms*);

**long-term planning** means the planning of supply and transportation capacity of natural gas undertakings on a long-term basis with a view to meeting the demand for natural gas of

the system, diversification of sources and securing supplies to customers (*Directive 2003/55/EC*);

**losses** - the general term applied to energy (kWh) and capacity (kW) lost in the operation of an electric system. Losses occur principally as energy transformations from kWh to waste-heat in electrical conductors and apparatus. This waste-heat in electrical conductors and apparatus. This power expended without accomplishing useful work occurs primarily on the transmission and distribution system (*ERRA Legal Regulation Working Group Terms*);

## **M**

**majeur force** - a superior force, an event that no human foresight could anticipate or which if anticipated, is too strong to be considered e.g an industrial strike which leads to loss of profits. Circumstances must be abnormal and unforeseeable, so that the consequences could not have been avoided through the exercise of all due care (*ERRA Legal Regulation Working Group Terms*);

**market-based-price**- a price set by the mutual decisions of many buyers and sellers in a competitive market (*ERRA Legal Regulation Working Group Terms*);

**monopoly** - the only seller with control over market sales (*ERRA Legal Regulation Working Group Terms*);

## **N**

**natural gas undertaking** means any natural or legal person carrying out at least one of the following functions: production, transmission, distribution, supply, purchase or storage of natural gas, including LNG, which is responsible for the commercial, technical and/or maintenance tasks related to those functions, but shall not include final customers (*Directive 2003/55/EC*);

**natural monopoly** - market condition where there are the limited technical possibilities, that are defining the best service without the competition and the service provided by the natural monopolist cannot be replaced by any of the others' (*ERRA Legal Regulation Working Group Terms*) ;

**network** - a system of transmission and distribution lines cross-connected and operated to permit multiple power supply to any principal point on it. A network is usually installed in urban areas. It makes it possible to restore power quickly to customers by switching them to another circuit (*ERRA Legal Regulation Working Group Terms*);

**new interconnector** means an interconnector not completed by the date of entry into force of this Regulation (*Regulation (EC) No. 1228/2003*).

**new infrastructure** means an infrastructure not completed by the entry into force of this Directive (*Directive 2003/55/EC*);

**non-household customers** means any natural or legal persons purchasing electricity which is not for their own household use and shall include producers and wholesale customers (*Directive 2003/54/EC*);

**non-household customers** means customers purchasing natural gas which is not for their own household use (*Directive 2003/55/EC*);

## O

**open access** - access to the electric transmission system by any legitimate market participant, including utilities, independent power producers, cogenerators, and power marketers (*ERRA Legal Regulation Working Group Terms*);

**operation and maintenance expenses** - costs that relate to the normal operating, maintenance and administrative activities of a business (*ERRA Legal Regulation Working Group Terms*);

**operation in parallel regimes** - when power systems of two or more countries are working in parallel (*ERRA Legal Regulation Working Group Terms*);

**outage** - time during which service is unavailable from a generating unit, transmission line, or other facility (*ERRA Legal Regulation Working Group Terms*);

**overload** - the flow of electricity into conductors or devices when normal load exceeds capacity (*ERRA Legal Regulation Working Group Terms*);

## P

**peak demand** - maximum power used in a given period of time (*ERRA Legal Regulation Working Group Terms*);

**petition** - a written application asking for relief or remedy (*ERRA Legal Regulation Working Group Terms*);

**plant** - a facility containing prime movers, electric generators, and other equipment for producing electric energy (*ERRA Legal Regulation Working Group Terms*);

**power grid** - a network of power lines and associated equipment used to transmit and distribute electricity over a geographic area (*ERRA Legal Regulation Working Group Terms*);

**power plant** - a generating station where electricity is produced (*ERRA Legal Regulation Working Group Terms*);

**power pool** - two or more interconnected electric systems that agree to coordinate operations (*ERRA Legal Regulation Working Group Terms*);

**power purchase agreement** - this refers to a contract entered into by an independent power producer and an electric utility. The power purchase agreement specifies the terms and conditions under which electric power will be generated and purchased. Power purchase agreements require the independent power producer to supply power at a specified price for the life of the agreement. While power purchase agreements vary, their common elements include: specification of the size and operating parameters of the generation facility; milestones in-service dates, and contract terms; price mechanisms; service and performance obligations; dispatchability options; and conditions of termination or default (*ERRA Legal Regulation Working Group Terms*);

**producer** means a natural or legal person generating electricity (*Directive 2003/54/EC*);

**production** - the act or process of generating electric energy (*ERRA Legal Regulation Working Group Terms*);

**public law** - is the set of legal principles governing the exercise of power by public authorities. Public law remedies are those procedures by which citizens can challenge the fairness or legality of their decisions (*ERRA Legal Regulation Working Group Terms*);

**public service** - concept that embraces both bodies providing services and the general-interest services they provide. Public-service obligations may be imposed by the public authorities on the body providing a service (airlines, road or rail carriers, energy producers and so on), either nationally or regionally (*ERRA Legal Regulation Working Group Terms*);

**public utility** - a utility operated by a non-profit governmental or quasi-governmental entity. Public utilities include municipal utilities, cooperatives, and power marketing authorities (*ERRA Legal Regulation Working Group Terms*);

**publicly owned utilities** - municipal utilities (utilities owned by branches of local government) and/or co-ops (utilities owned cooperatively by customers) (*ERRA Legal Regulation Working Group Terms*);

## **R**

**regulation** - an activity to control or direct economic entities by rulemaking and adjudication (*ERRA Legal Regulation Working Group Terms*);

**regulated tariff** price defined by the regulator under the limited competition conditions, that could be fixed, marginal, upper margin; or lower margin and upper margin simultaneously (*ERRA Legal Regulation Working Group Terms*);

**regulation** - regulator influences over the price and price making process within the competence determined by the legislation and regulations, enacting the relevant regulations, supervision and monitoring (*ERRA Legal Regulation Working Group Terms*).

**regulatory fee** - annual fee paid to the regulatory budget by the licensee for regulatory service (*ERRA Legal Regulation Working Group Terms*);

**related undertakings** means affiliated undertakings, within the meaning of Article 41 of the Seventh Council Directive 83/349/EEC of 13 June 1983 based on the Article 44(2)(g) (\*) of the Treaty on consolidated accounts (2), and/or associated undertakings, within the meaning of Article 33(1) thereof, and/or undertakings which belong to the same shareholders (*Directive 2003/55/EC*);

**reliability** - electric system reliability has two components - adequacy and security. Adequacy is the ability of the electric system to supply the aggregate electric demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system facilities. Security is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system facilities (*ERRA Legal Regulation Working Group Terms*);

**renewable energy** - energy that is capable of being renewed by the natural ecological cycle (*ERRA Legal Regulation Working Group Terms*);

**renewable energy sources** means renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases) (*Directive 2003/54/EC*);

**restructuring** - the reconfiguration of the vertically-integrated electric utility. Restructuring usually refers to separation of the various utility functions into individually-operated and-owned entities (*ERRA Legal Regulation Working Group Terms*);

**retail** - sales of electric energy to the ultimate customer (*ERRA Legal Regulation Working Group Terms*);

**retail company** - a company that is authorized to sell electricity directly to industrial, commercial and residential end-users (*ERRA Legal Regulation Working Group Terms*);

## **S**

**security** means both security of supply and provision of electricity, and technical safety; (*Directive 2003/54/EC*);

**security** means both security of supply of natural gas and technical safety (*Directive 2003/55/EC*);

**storage facility** means a facility used for the stocking of natural gas and owned and/or operated by a natural gas undertaking, including the part of LNG facilities used for storage but excluding the portion used for production operations, and excluding facilities reserved exclusively for transmission system operators in carrying out their functions (*Directive 2003/55/EC*);

**storage system operator** means a natural or legal person who carries out the function of storage and is responsible for operating a storage facility (*Directive 2003/55/EC*);

**supplier** - a person or corporation, generator, broker, marketer, aggregator or any other entity, that sells electricity to customers, using the transmission or distribution facilities of an electric distribution company (*ERRA Legal Regulation Working Group Terms*);

**supply** means the sale, including resale, of electricity to customers (*Directive 2003/54/EC*);

**supply** means the sale, including resale, of natural gas, including LNG, to customers (*Directive 2003/55/EC*);

**supply undertaking** means any natural or legal person who carries out the function of supply (*Directive 2003/55/EC*);

**system** means any transmission networks, distribution networks, LNG facilities and/or storage facilities owned and/or operated by a natural gas undertaking, including linepack and its facilities supplying ancillary services and those of related undertakings necessary for providing access to transmission, distribution and LNG (*Directive 2003/55/EC*);

**system (Electric)** - physically connected generation, transmission, and distribution facilities operating as a single unit (*ERRA Legal Regulation Working Group Terms*);

**system users** means any natural or legal persons supplying to, or being supplied by, a transmission or distribution system (*Directive 2003/54/EC*);

**system users'** means any natural or legal persons supplying to, or being supplied by, the system  
(*Directive 2003/55/EC*);

## **T**

**tariff** - a document, approved by the responsible regulatory agency, listing the terms and conditions, including a schedule or prices, under which utility services will be provided (*ERRA Legal Regulation Working Group Terms*);

**transmission** means the transport of electricity on the extra high-voltage and high-voltage interconnected system with a view to its delivery to final customers or to distributors, but not including supply (*Directive 2003/54/EC*);

**transmission** means the transport of natural gas through a high pressure pipeline network other than an upstream pipeline network with a view to its delivery to customers, but not including supply (*Directive 2003/55/EC*);

**transmission** - the act or process of transporting electric energy in bulk (*ERRA Legal Regulation Working Group Terms*);

**transmission and distribution (T&D) losses** - losses the result from the friction that energy must overcome as it moves through wires to travel from the generation facility to the customer. Because of losses, the demand produced by the utility is greater than the demand that shows up on the customer bills (*ERRA Legal Regulation Working Group Terms*);

**transmission and distribution (T&D) system** - an interconnected group of electric transmission lines and associated equipment for the movement or transfer of electric energy in bulk between points of supply and points at which it is transformed for delivery to the ultimate customers (*ERRA Legal Regulation Working Group Terms*);

**transmission lines** - heavy wires that carry large amounts of electricity over long distances from a generating station to places where electricity is needed. Transmission lines are held high above the ground on tall towers called transmission towers (*ERRA Legal Regulation Working Group Terms*);

**transmission system operator** means a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long term ability of the system to meet reasonable demands for the transmission of electricity;(*Directive 2003/54/EC*)

**transmission system operator** means a natural or legal person who carries out the function of transmission and is responsible for operating, ensuring the maintenance of, and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transportation of gas (*Directive 2003/55/EC*);

**transmitting utility** - this is a regulated entity which owns, and may construct and maintain, wire used to transmit wholesale power. It may or may not handle the power dispatch and coordination functions. It is regulated to provide non-discriminatory connections, comparable service and cost recovery (*ERRA Legal Regulation Working Group Terms*);

## **U**

**unbundling** - disaggregating electric utility service into its basic components and offering each component separately for sale with separate rates for each component. For example, generation, transmission and distribution could be unbundled and offered as discrete services (*ERRA Legal Regulation Working Group Terms*);

**universal service** - electric service sufficient for basic needs (an evolving bundle of basic services) available to virtually all members of the population regardless of income (*ERRA Legal Regulation Working Group Terms*);

**utility** - a regulated entity which exhibits the characteristics of a natural monopoly. For the purposes of electric industry restructuring "utility" refers to the regulated, vertically-integrated electric company. "Transmission utility" refers to the regulated owner/operator of the transmission system only. "Distribution utility" refers to the regulated owner/operator of the distribution system which serves retail customers (*ERRA Legal Regulation Working Group Terms*);

**upstream pipeline network** means any pipeline or network of pipelines operated and/or constructed as part of an oil or gas production project, or used to convey natural gas from one or more such projects to a processing plant or terminal or final coastal landing terminal (*Directive 2003/55/EC*);

## V

**vertical integration** - an arrangement whereby the same company owns all the different aspects of making, selling, and delivering a product or service. In the electric industry, it refers to the historically common arrangement whereby a utility would own its own generating plants, transmission system, and distribution lines to provide all aspects of electric service (*ERRA Legal Regulation Working Group Terms*);

**vertically integrated undertaking** means an undertaking or a group of undertakings whose mutual relationships are defined in Article 3(3) of Council Regulation (EEC) No 4064/89 of 21 December 1989 on the control of concentrations between undertakings (1) and where the undertaking/group concerned is performing at least one of the functions of transmission or distribution and at least one of the functions of generation or supply of electricity (*Directive 2003/54/EC*);

**vertically integrated undertaking** means a natural gas undertaking or a group of undertakings whose mutual relationships are defined in Article 3(3) of Council Regulation (EEC) No 4064/89 of 21 December 1989 on the control of concentrations between undertakings (1) and where the undertaking/group concerned is performing at least one of the functions of transmission, distribution, LNG or storage, and at least one of the functions of production or supply of natural gas (*Directive 2003/55/EC*);

## W

**wholesale customers** means any natural or legal persons who purchase electricity for the purpose of resale inside or outside the system where they are established; (*Directive 2003/54/EC*)

**wholesale customers** means any natural or legal persons other than transmission system operators and distribution system operators who purchase natural gas for the purpose of resale inside or outside the system where they are established (*Directive 2003/55/EC*);

**wholesale power market** - the purchase and sale of electricity from generators to resellers (who sell to retail customers) along with the ancillary services needed to maintain reliability and power quality at the transmission level (*ERRA Legal Regulation Working Group Terms*).